A Dissertation on

A COMPARATIVE STUDY OF BENIGN VOCAL CORD MASS LESIONS USING VIDEOSTROBOSCOPY,VOICE ANALYSIS AND VOICE HANDICAP INDEX BEFORE AND AFTER MICROLARYNGEAL SURGERY

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DECLARATION

I, **Dr. RAVIKUMAR.V,** solemnly declare that the dissertation, titled "**A COMPARATIVE STUDY OF BENIGN VOCAL CORD MASS LESIONS USING VIDEOSTROBOSCOPY,VOICE ANALYSIS AND VOICE HANDICAP INDEX BEFORE AND AFTER MICROLARYNGEAL SURGERY**" is bonafidework done by me during the period of Dec 2014 to September 2015 at Government Stanley Medical College and Hospital, Chennai under the expert supervision of

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CERTIFICATE

This is to certify that the dissertation - "**A COMPARATIVE STUDY OF BENIGN VOCAL CORD MASS LESIONS USING VIDEOSTROBOSCOPY, VOICE ANALYSIS AND VOICE HANDICAP INDEX BEFORE AND AFTER MICROLARYNGEAL SURGERY**" presented by Dr. RAVIKUMAR.V, is an original work done in the department of otorhinolarymgology, Government Stanley Medical College and hospital, Chennai in partial fulfilment of regulations of the The Tamil Nadu Dr. M.G.R. Medical University, for the award of degree of M.S. (Otorhinolaryngology) Branch IV, under my supervision during the academic period 2013-2016.

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ABSTRACT

ABSTRACT

Vocal cords are very delicated and intricate structure that help a human being to Breath, Speak as well as to sings. It is a micro structure and their functions are very accurate, even a small change in it by a lesion can produce enormous change in its function (Voice and Singing). Video Laryngo Stroboscopy is the process in which the normal and pathological vibrating pattern of vocal cord is made visible during phonation. Voice is analysed using Voice analyser and Voice Handicap Index.

AIM

The present study is aimed at examining the objective and subjective parameters using Stroboscopy voice analysis and Voice Handicap Index(VHI) of patients with Benign Vocal Cord Lesions before and after Microlaryngeal surgery.

METHOD

This study was conducted in the Department of Otorhinolaryngology of Government Stanley Medical College and Hospital during the period of December 2014 to September 2015. Based on the inclusion and exclusion criteria,38 patients with voice disorders

were selected and sub categorized into Vocal Cord Nodule, Vocal cord Polyp, Vocal cord Cyst.

Among 38 Patients 16 are presented as Vocal cord Nodule,16 Presented as Vocal cord Cyst and 6 Presented as Vocal Cord Polyp which includes both male and females. After getting valid consent from the patients, pre operative and Postoperative subjective and objective parameters using Stroboscopy voice analysis and Voice Handicap Index(VHI) were evaluated and analysed.

RESULTS

Pre and Post operative assessment of patients with benign vocal cord mass lesions using stroboscopy, voice analyses and Voice Handicap index is a useful way to assess the degree of improvement following surgery. Both the patients and surgeon were provided with definitive evaluation with respect to the benefit following surgery and speech therapy.

INTRODUCTION

INTRODUCTION

The voice is an integral part of the unique human ability to communicate by speech. The larynx is the major source of sound used during speaking. Phonation is the generation of sound by vibration of vocal cords. Benign vocal cord mass lesions such as polyps, nodules and cysts affect voice production.

The objective measurement of the degree of pathology in the vocal folds is performed by using various parameters of videostrobosocopic examination.

A comparison of pre operative and post operative changes in the vocal folds can show the degree of improvement. Videostrobosocopic examination may also be combined with analysis of voice parameters to assess the improvement or worsening of voice after Micro Laryngeal surgery.

The present study aimed at examining the subjective and objective parameters using stroboscopic voice analysis and VHI Of patients undergoing Microlaryngeal Surgery for Benign Vocal Cord Mass Lesions.

AIM AND OBJECTIVES

AIM OF THE STUDY

A Comparative Study Of Benign Vocal Cord Mass Lesions Using Videostroboscopy, Voice Analysis And Voice Handicap Index Before And After Microlaryngeal Surgery.

OBJECTIVE OF THE STUDY

1. Comparing pre and post operative vocal cord vibratory changes in a patient with benign vocal cord lesions using stroboscopy.
2. Comparing pre and post operative voice changes in a patient with benign vocal cord mass lesions using voice analysis.
3. Assessing the subjective improvement of patients voice using voice handicap index before and after Microlaryngeal Surgery.
4. To assess the predictive value of the tests.

INCLUSION CRITERIA

1. Patients with benign looking vocal cord lesion
2. Age more than 12 years
3. On Rigid fiberoptic endoscopy / indirect Laryngoscopy vocal cords should be freely mobile.

EXCLUSION CRITERIA

1. Patient with malignant looking lesion on endoscopy.

2. Patient in respiratory distress

3. Patient with ischemic heart disease.

4. Inability of patients to return for follow up at six weeks.

REVIEW
OF LITERATURE

REVIEW OF LITERATURE

EMBRYOLOGY OF LARYNX (Fig 1)

1. Development of larynx begins at 4th week of intrauterine life in the form of laryngotracheal groove which is nothing but the midline ventral respiratory diverticulum of the foregut. This groove gradually deepens and fused to form a septum which separates the laryngotracheal tube from the larynx and oesophagus.

2. This fusion starts caudally and extends cranially. Cranial end forms the larynx and trachea, Caudal end divides into two from which two main bronchi develop.

3. Epiglottis develop from the posterior part of hypobranchial eminence.

4. **DEVELOPMENT OF LARYNGEAL CARTILAGE**

- Thyroid cartilage – Ventral ends of 4th arch cartilage
- Arytenoids – 6th arch
- Corniculate – 6th arch
- Cueniform-6^{th} arch
- Epiglottis – Hypobranchial eminence
- Cricoid &Tracheal Cartilage – 6thbranchial arch

5. Laryngeal muscles develops from Muscle elements in branchial arch IV, V, VI [01,02.]

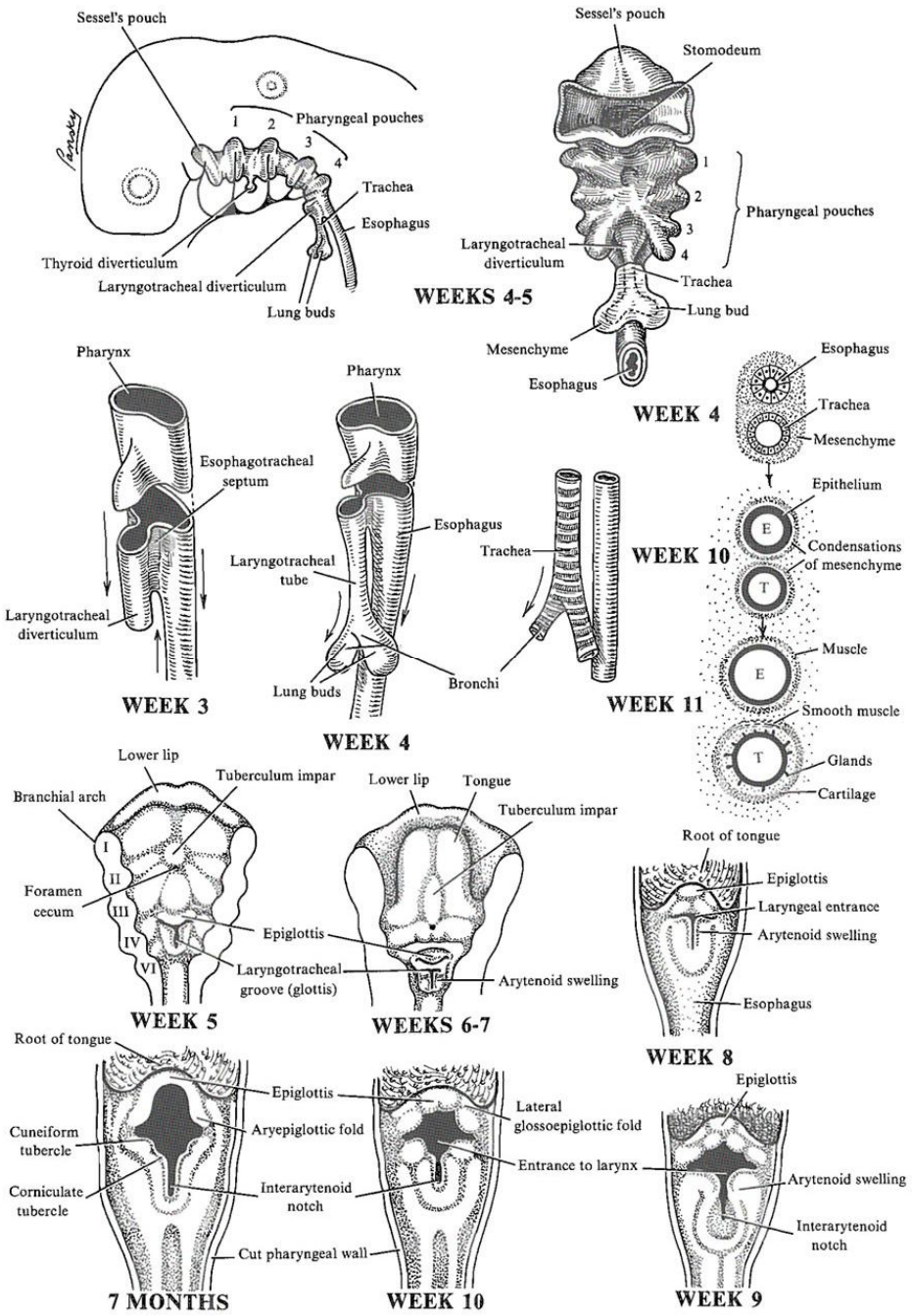

Fig-1 Various Stages of Development of larynx.

FRAMEWORK OF LARYNX

Definition:

Larynx composed of articulated cartilages interconnected by Ligaments, internally invested by mucosa, acted upon by muscles supplied by blood vessels and nerves and drained by lymphatics. Situated from C3 to C6 Vertebra in men, Somewhat higher in women and children.

Dimension of Larynx [2A]

SEXES	LENGTH	TRANSVERSE DIAMETER	ANTEROPOSTERIOR DIAMETER	CIRCUMFERENCE
MALES	44mm	43mm	36mm	136mm
FEMALES	36mm	41mm	26mm	112mm

Table:-1 Dimension Of Larynx

CARTILAGES OF LARYNX

The Cartilage of larynx divided into Paired and unpaired. Paired cartilages are three in numbers named 1.Corniculate 2. Cuneiform 3.Aretynoids. Unpaired cartilages are also three in number named 1.Thyroid 2.Cricoid 3.Epiglottis.

THYROID CARTILAGE

Shield in Shape, Consists of two pentagonal plates which meets anteriorly in midline to form an angle of 90 degree in men and 120 degree in women. It is largest of all laryngeal cartilages. The fused anterior border in men produce a prominence which is easily palpable and known as "ADAMS APPLE" Lamina of thyroid cartilage deviated posteriorly and prolonged to form a slender process called superior and inferior cornua. Superior cornua is curves upward and backward and medially and ends in a conical projection where thyrohyoid ligament attached. The short and thicker inferior cornua arches downward medially and articulate with the small facet present in the cricoid cartilage.

In the Outer surface of lamina there is a oblique line extending from the superior thyroid tubercle to inferior thyroid tubercle. Following structures attached to the oblique line, they are 1.Thyrohyoid muscle 2.Sternohyoid muscle 3.Inferior Constrictor Muscle. Inner part of lamina covered by mucous membrane.

CRICOID CARTILAGE

It is the only cartilage having a complete cartilaginous ring in the airway system. It has narrow arch anteriorly and broad lamina posteriorly. Lamina has facets for arytenoids near the junction of arch and lamina for inferior horn of thyroid cartilage. It is a synovial type

of joint, its vertical line gives attachment to oesophageal longitudinal fibres. Superior margin gives attachment to the cricothyroid ligament. Lateral gives attachment to the crico arytenoid muscle.

ARYTENOID CARTILAGES

It positioned at upper and lateral border of cricoid lamina. Shape looks like irregular three sided pyramid. Its forward projection is called as Vocal Process, Lateral projection is called as Muscular process – to which posterior and lateral cricoarytenoids attached. Medial surface gives attachment to vestibular ligaments upper part and lower part gives attachment to crico arytenoid muscle.

CORNICULATE (SANTORINI) AND CUNEIFORM (WRISBERG) CARTILAGES

Small conical nodule like structure two in number which is a type of fibroelasticcartilage and articulate as a synovial joint. In front of corniculate, the elongated cuneiform cartilage present. They are enclosed in aryepiglottic fold.

EPIGLOTTIS

Type of elastofibro cartilage thin leaf like sheet projecting behind the tongue and hyoid bone body. Below the thyroid notch, a narrow stalk is attached by the thyroepiglottic ligament to the angle between thyroid lamina. At sides there is aryepiglottic folds. It's

posterior surface is concave, smooth and with a central tubercle.Median and lateral glossoepiglottic folds forming vallecula presents at anterior surface. Hyoepiglottic ligament is connected to hyoid.

LIGAMENTS

EXTRINSIC	INTRINSIC
1. Thyrohyoid membrane 2. Median thyrohyoid ligament 3. Lateral thyrohyoid ligament (enclose cartilago triticea) 4. Cricotracheal Ligament 5. Hyo Epiglottic ligament	a) Quadrilateral membrane between epiglottis and arytenoid i) Aryepiglottic fold Upper Borders ii) Vestibular ligament lower Margin b) Conus Elasticus (Cricothyroid or cricovocal ligament) i) Vocal ligament – upper border

Table-2-Ligaments

MUCOUS MEMBRANE

The Mucous Membrane continuous with lining of pharynx above and below with trachea. It is rich in mucous glands especially in the region of ventricle of morgagni (Laryngeal ventricle). This mucous membrane closely adherent to epiglottis, aryepiglottic fold and vocal cords . The Lining epithelium of larynx are squamous , ciliated columnar or transitional.

LARYNGEAL MUSCLES

The Laryngeal muscles are subdivided into intrinsic, extrinsic and accessory.

INTRINSIC LARYNGEAL MUSCLES

Based on the effect on the shape of glottis and vibratory behavior of vocal cord they are classified into addcutors, abductors, relaxers and tensor muscles.

THE POSTERIOR CRICOARYTENOID MUSCLE

The Posterior cricoarytenoid muscle originate behind the cricoid cartilage and get inserted into the muscular processes of arytenoids. In humans the PCA composed of vertical and horizontal comportments insert into the lateral and medial aspect of muscular process of arytenoids. Each of these comportments receive its own nerve from recurrent laryngeal nerve and have different function.

The functions of PCA during phonations is unclear but widely accepted that it pulls the vocal fold away during voice.

INTERARYTENOID MUSCLE

It is an unpaired muscle get originated from the posterior aspect of each arytenoids cartilage. It mainly approximates the posterior end of

arytenoid cartilage there by it has major role in the phonatory and sphincteric mechanism of larynx.

LATERAL CRICOARYTENOID MUSCLE

This muscle originates from the cricoids arch and inserted into the muscular processes of arytenoids cartilage. Its main function is to adducts the vocal folds.

THE THYROARYTENOID MUSCLE

Through isometric contraction the muscle can influence the tension of vocal folds and can affect vibration ability. The M,Vocalis rises the medical section of the M. thyroarytaenoideus from the inner surface of the anterior surface of the thyroid cartilage and appears in the form of thin projection on the front surface of the processus vocalis of the artyenoid cartilage.

They serve as an elastic receptor and are responsible for a control system in the measurement of the tension and the length of the muscle fibres.[4]

Table 3[3]					
Function of Laryngeal Muscles in vocal cord					
	CT	**VOC**	**LCA**	**IA**	**PCA**
Position	Paramedian	Adduct(Membranous portion)	Adduct(Entire Fold)	Adduct (Cartilaginous portion)	Abduct
Level	Lower	Lower	Lower	--	Elevate
Length	Elongate	Shorten	Elongate	(Shorten)	Elongate
Thickness	Thin	Thicken	Thin	(Thicken)	Thin
Edge	Sharpen	Round	Sharpen	--	Round
Cover	Stiffen	Slacken	Stiffen	Slacken	Stiffen
Transition	Stiffen	Slacken	Stiffen	Slacken	Stiffen
Body	Stiffen	Stiffen	Stiffen	Slacken	Stiffen

Table-3-Functions of Laryngeal Muscles in Vocal Cord.

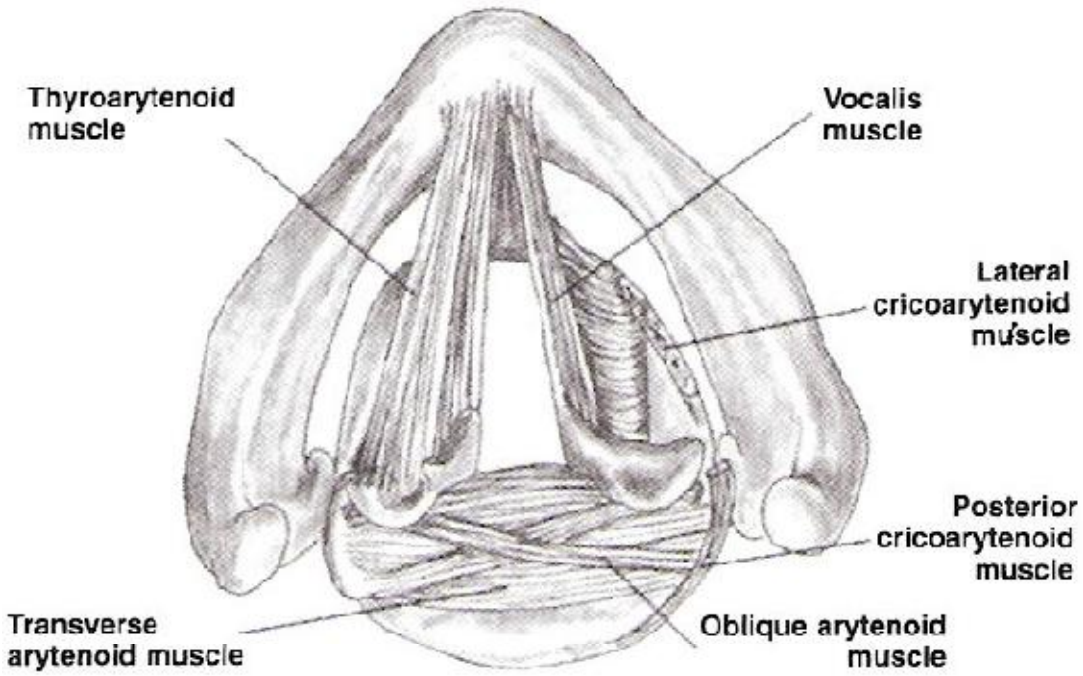

Fig-2 Larynx – Intrinsic muscles

FUNCTIONAL ANATOMY

Many Factors are involved in the production of the human voice. The vibration of vocal folds requires a highly differentiated and precisely co-ordinated series of many individual movements of the larynx, It is important to note the energy is reduced to a minimum while speaking, whereas during singing energy increases. The micro structure of the vocal folds is responsible for a precise series of movements. The vocal tract and neuro-anatomy of voice production plays a fundamental role in voice production and biochemical and biophysical factors are also influential.

MICROSTRUCTURE OF VOCAL FOLDS

This consists of

1. The Mucosa(Epithelium and parts of the lamina propria)
2. The Vocalis muscle complex.

LAMINA PROPRIA

The tissue of lamina propria connects to the epithelial layer of the vocal fold. This can be differentiated into three layers.

1. The Supericial layer :This consists of a light connective tissue rich in blood vessels and nerves; the superficallayer of the lamina propria

the subepithelial connective tissue-is analogous to the Reinke's space.

2. The intermediate layer : This consists much elastic tissue
3. The Deep Layer : It Consists mainly of collagen fibres, but also contains elastic fibres.

VOCAL CORD (VOCAL LIGAMENT) AND CONUS ELASTICUS

These are formed out of the intermediate and deep layer of the lamina propria. The vocal ligament alone forms the upper free edge of the conus elasticus.

M. THYROARYTAENOIDEUS(M.VOCALIS)

Through isometric contraction the muscle can influence the tension of vocal folds and can affect vibration ability. The M,Vocalis rises the medical section of the M. thyroarytaenoideus from the inner surface of the anterior surface of the thyroid cartilage and appears in the form of thin on the front surface of the processus vocalis of the artyenoid cartilage.

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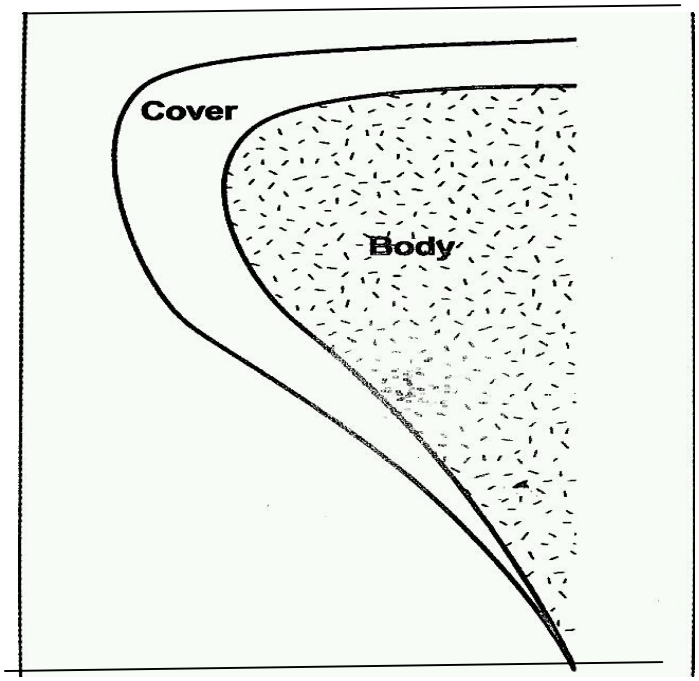

Fig 3A Body Cover Complex[7]

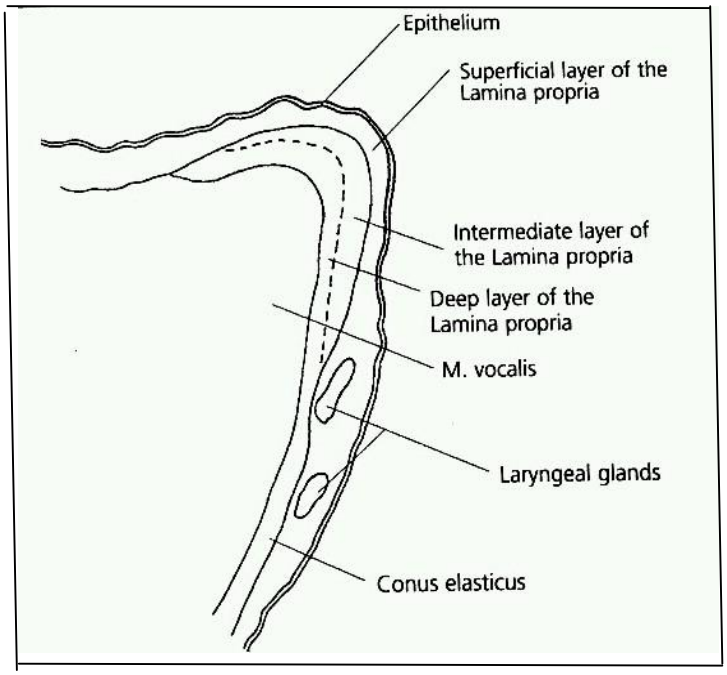

Fig 3B Body Cover Complex

FUNCTIONAL TWO-LAYERED STRUCTURE OF THE VOCAL FOLDS

Five-layered schema		Body-Cover-Model	
Epithelium		Mucosa	Cover
Lamina propria	Superficial Layer		
	Intermediate Layer	Vocal Ligament	Transition
	Deep Layer		
M. Thyroarytaenoideus		Muscle	Body

Table-4- **FUNCTIONAL TWO-LAYERED STRUCTURE OF THE VOCAL FOLDS**

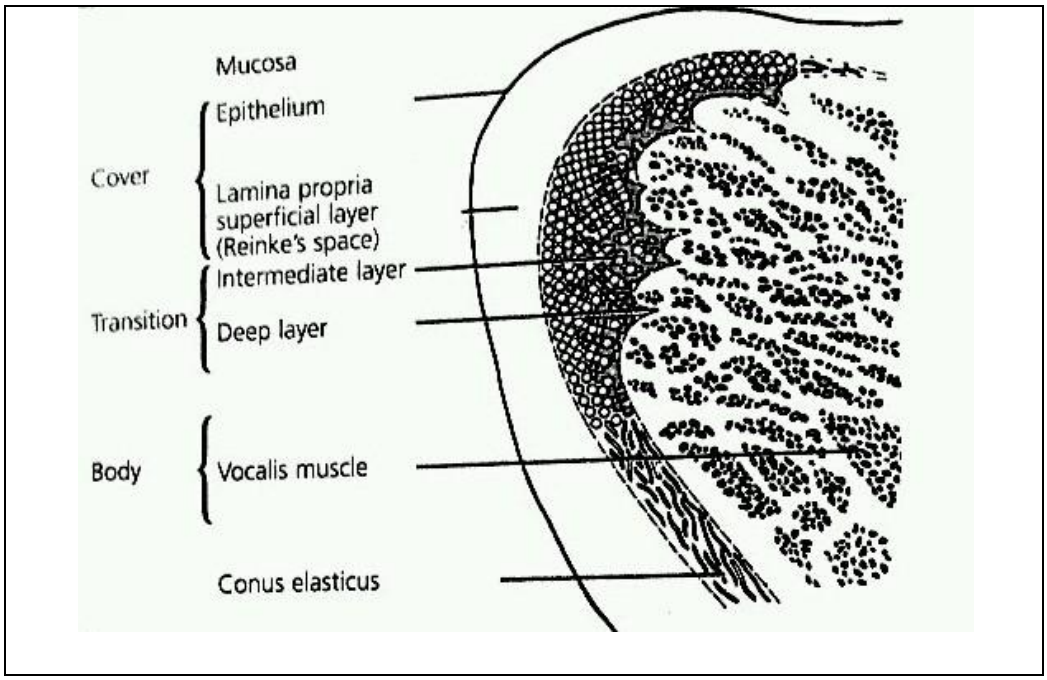

Fig 4-Cover Body Complex

THE BASEMENT MEMBRANE ZONE

This is an area between the epithelium and the superficial layer of the superficial layer of lamina propria. The basal cells of epidermis is attached by the attachment plaques (AP) to the sub-basal dense plate (DP) to the

anchoring filaments(AFL) through the lamina densa of the BMZ to the anchoring fibers to the superficial layer of the lamina propria. Many of the structures are composed of one or more proteins. One such protein, epidermolysis bullosa acquisita (EBA) is involved in the actual attachments of the epithelium to the underlying tissue.[5]

The lamina densa area contains proteins that add strength to the BMZ. Type IV collagen is also found in the lamina densa region.The BMZ is very susceptible to injury due to vibration and shearing forces.

The fibers that anchor the BMZ loop from the lamina densa into the superficial layer of the lamina propria and then back to the lamina densa. Type III collagen fibers also appear to pass through these loops creating an arrangement that resembles a chain link fence. The lamina densa area contains proteins that add strength to the BMZ.

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Disease and trauma may damage these fragile connection links between the epithelium and the BMZ. It is conjectured that some aberrations of or injury to the BMZ maybe the cause of nodules and benign

lesions. Once laid down, it tends to stay and had been implicated in scar formation. It has been found in human vocal nodules. But neither fibronectin nor collagen type II is found in human polyps[5] .

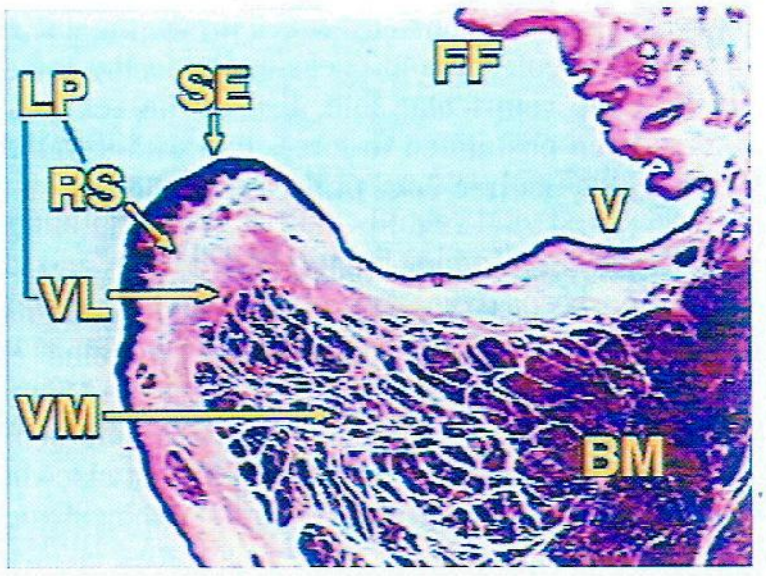


Fig 5A-vocal cord cross sectional study. (SE- squamous epithelium, LPlamina propria, RS- Reinke's space, VL- vocal ligament, VM- vocalis muscle, BM- body of thyroarytenoid muscle, V- ventricle, FF- false cord)

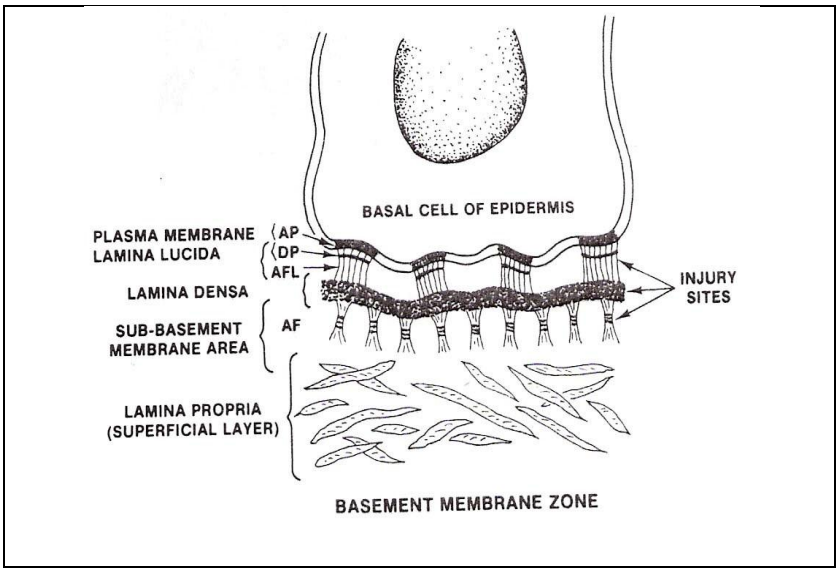


Fig 5B- Basement membrane zone (AP- attachment plaques, DP- dense plates, AFL- anchoring filaments, AF- anchoring fibers)

PHYSIOLOGY OF PHONATION

The voice is an integral part of the unique human ability to communicate by speech. The larynx is the major source of sound used during speaking. Phonation is the generation of sound by vibration of vocal cords.

THEORIES OF PHONATION[6]

It is based on three theories.

a) **Aerodynamic or myoelastic theory:** (Van den Berg - 1958) this theory postulates that vocal cords are subject to well established aerodynamic and physical forces. There is a building up of infraglottic air column, and its pressure act on the vocal folds which are kept tensed by the tonic contraction of the laryngeal muscles. This increased infraglottic pressure forces the vocal cords apart and it is set in vibration, once again the pressure falls, vocal cords recoil following which the subglottic pressure raises. The mode and frequency of vibration is dependent on properties of the cord and interplay of the intrinsic muscles of the larynx.

b) **Neuromuscular or clonic theory (Husson):** This is not accepted now. This states that each new vibratory cycles are initiated by nerve impulses transmitted from brain to the vocalis muscle by way of the vagus nerve. This means that the frequency of vocal cord vibration is dependent

on rate of impulses delivered. There was very little conclusive evidence to support this theory.

c) **Cavity tone or transient theory (Wills)** this states that larynx functions simply to supply puffs of air that might excite the supraglottal resonating cavity. This explains sound production based on the resonation chambers alone.

MECHANISM OF PHONATION

Phonation requires co-ordinated interaction of the mouth pharynx, larynx, diaphragm and neck muscles. Normal phonation requires five conditions[8]:

1) Adequate breath support

2) Approximation of vocal cords

3) Favorable vibrating properties

4) Favorable vocal cord shape

5) Control of length and tension.

The upward movement of diaphragm pushes air from the lungs through the vocal folds, producing a train of air pulses. This pulse train is shaped by the resonances of the vocal tract. Basic resonances called vocal formants, can be changed by the action of the articulators to produce distinguishable voice sounds, like vowels sounds[09]

PHONATORY PHYSIOLOGY

GLOTTAL TONE INITIATION[9]

The process of phonation begins with inhalation of air. The vocal folds are approximated in the midline or near the midline (phonatory postion) and the glottis space is obliterated. The subglottic pressure builds up to about 7cm of water, for conversational speech. The subglottic pressure then pushes the vocal cord progressively apart from the bottom up until a space develops. Bernoulli's effect of air flow along with the elastic forces of the cords begin to close the glottis almost immediately even while the upper edges are still separating. The upper portion of vocal cords has strong elastic properties which make the vocal cords to snap back to the midline completing the glottic cycle. Subglottic pressure then builds up again and events are repeated.

Bernoulli's effect is an important aerodynamic event responsible for closing the vocal cords. Bernoulli's law states that the sum of the static pressures at the kinetic pressures in a gas system is always equal to a constant. In the larynx, the vocal cords cause a partial obstruction of airflow. The molecules travelling along the sides of the trachea, when meeting the vocal cords, must travel a greater distance to meet the molecules in the centre of trachea. The molecules along the surface of vocal folds must increase their velocity and kinetic pressure. Thus the static pressure on the surface of the vocal folds will be decreased. Thus the

pliable and movable vocal folds will begin to move towards the centre of the trachea because of this pressure differential. Eventually, the two cords will meet in the midline, and airflow will cease.

When the cords close there is sudden decrease of airflow and when it opens there is a momentary delay in starting the flow of air due to the inertia.

This gives the characteristic shape of the airflow pulse through the glottis where the rising airflow phase is slower than the opening of the vocal folds. Intra glottis pressure is solely dependent on particle velocity.

It is necessary to properly tense and elongate the vocal cords prior to actually producing sounds, which is regulated by the laryngeal muscles. It is also important that in the myoelastic – aerodynalmic mechanism of phonation the vocal cords emit pulses of air and also there is a vertical phase difference; that is: the lower portion of vocal cord begins to open and close before the upper thus producing a rippling displacement of the vocal cord cover. Thus mucosal wave can be examined by stroboscopic light.

The vocal cord length, mass and tension determines the fundamental frequency. Fundamental frequency which corresponds to pitch can be altered by changing the air pressure or the mechanical properties of the vocal cord.

Contraction of cricothyroid muscle along with the thyroarytenoid muscle increases the length and tension of the vocal cords, resulting in raising the pitch.

In the lower vocal range, contraction of thyroarytenoid alone results in lower pitch because it decreases the tension in the vocal cover. Vocal frequency decrease as the mass of the cord increases. The vocal intensity corresponds to loudness.

The sound generated by vibration of the vocal cords is then modulated by the resonating chambers. Resonance is controlled by altering the shape and volume of pharynx, by raising and lowering the larynx, by moving tongue or jaw position, or by the nasopharynx and nose. Voice training for singing, acting and public speaking concentrates heavily on refining and maximizing resonance. The goal is to produce the most loudest and pleasing sound with minimal strain or pressure on the larynx.

COMMON VOICE COMPLAINTS

Hoarseness means change in voice. This term is used by patients to describe changes in their voice quality. Dysphonia means abnormal voice, but the degree of dysphonia does not correlate with any particular specific cause. It may present with mild, moderate, or severe dysphonia.

The symptoms of dysphonia may be further subclassified, as Diplophonia (double-tone), Dysresonance (change in the resonance of the voice). Voice breaks exemplify pitch-specific dysphonias. Odynophonia implies uncomfortable or painful speaking. Vocal fatigue is a common symptom among voice disorder patients and implies the development of symptoms (dysphonia or odynophonia) sometime after the initiation of vocalization[10] .

Aphonia is used to describe the loss of voice; such patients may still be able to communicate in a quiet environment using the airstream for articulation, but the glottis does not participate in phonation. The sound of aphonia, then, is characteristically no voice or extreme breathiness.

EVALUATION

Evaluation of the voice includes examination of the laryngeal structures by stroboscopy voice analysis. Additionally, administration of the Voice Handicap Index (VHI) provides an assessment of the level of handicap experienced by the patient with the voice disorder.

STROBOSCOPY

It is a technique for observation of laryngeal vibration which was first performed by Oertel in 1878.

BASIC PRINCIPLE OF STROBOSCOPY

The vocal folds vibrate at a frequency of approximately 250 times per second the human eye cannot discern necessary detail during rapid motion. The vocal folds vibrates at such a high frequency that their movements cannot be recorded during an indirect laryngoscopy or an endoscopy via rigid endoscopylaryngoscopy without additional apparatus. However with the aid of stroboscopy vibration can be observed.

TALBOT'S LAW & STILL AND MOVING IMAGES

Stroboscopy is based on Talbolt's Law. It states that the images on the human retina linger for 0.2 seconds after exposure. Therefore the sequential images produced at intervals of less than 0.2 seconds(more than 5 images per sec) produce the illusion of a continuous image. The stroboscopy actually illuminate different point on successive wave of vibratory cycles, each of which is retained on the retina for 0.2 sec. The light source of the machine emit intermittent flash at a rate that can be set by examiner or controlled by fundamental frequency of voice. When vocal cord vibrations and the stroboscopy light are synchronized the vocal cord will appear still rather than moves in slow motion. The frequency of the examinee sustained voice is picked up by the microphone and trigger the light source. When the flashes are emitted at the same frequency as that of

the vocal cord vibration, that is, at an identical phase point in successive vibratory cycle a sharp and clear images of the vocal cord is observed. When the frequency of the flashes is less or greater than vocal vibration, and there is a delay in the portion of the vibrating cycle illuminated and the illusion of slow motion is obtained.

The parameters studied by stroboscopy include symmetry, amplitude, periodicity, completeness of vibratory closure, and the mucosal wave pattern.

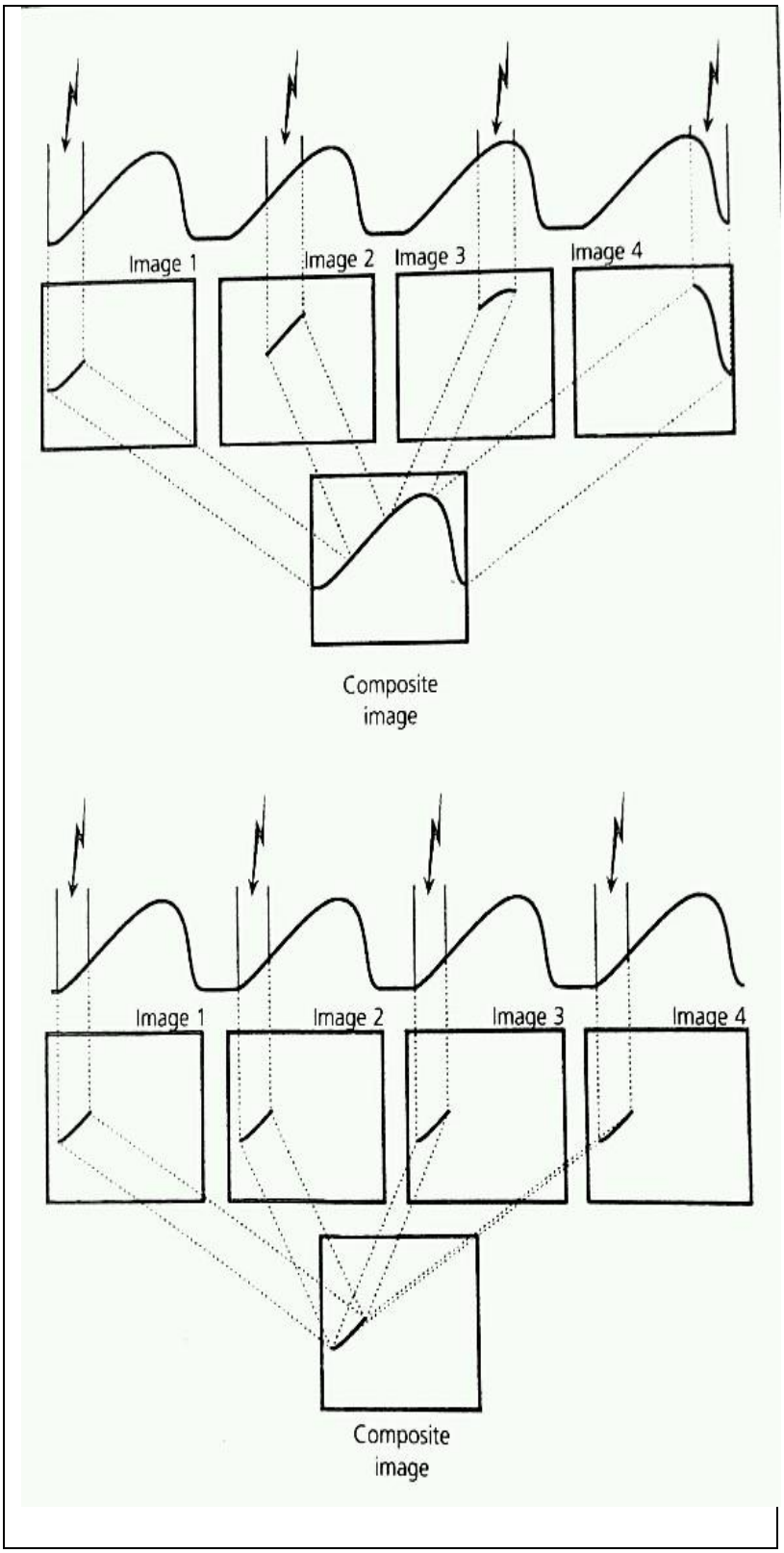


Fig : 6 Still and moving above. Above : a moving image is obtained through the illumination of consecutive phases. Below: a still image obtained through multi – illumination of the same vibration phase.

THE PARAMETERS STUDIED BY STROBOSCOPY ARE DESCRIBED BELOW

1) FUNDAMENTAL FREQUENCY

The rate at which the vocal cord vibrate for 1 second is called fundamental frequency. It varies from person to person. Usually lower in males and compare to females.

2) PERIODICITY

It refers to the regularity of successive vocal movement. A Periodicity occurs when the vocal folds vibrations follows each other at the same interval which mainly depends on balanced control of expiratory force and the mechanical characteristics of the vocal folds.

Aperiodic movements is caused either by inability to maintain a steady expiration stream of air or inability to sustain steady laryngeal muscle contraction or difference in the mass or stiffness of one of the vocal cords.

3) AMPLITUDE

This refers to the medio - lateral deflection of each individual vocal folds usually it is one third of the total width of vocal card .when the voice intensity increases(loud phonation) the amplitude increases as well . In case

of pathological increase of stiffness in the vocal fold, amplitude will decrease.

4) MUCOSAL WAVE

A Mucosal wave involves wave shaped shift of the mucosa (Epithelium and lamina propria) in contrasts to the tonalise M.Vocalis. Its decreased by musosal stiffness, masses, scarring, dryness. Loud phonation may increase the mucosal wave.

5) GLOTTIC CLOSURE

In normal individual complete closure of the membranous portion of the vocal cord occurred, however in some individual the posterior cartilaginous glottis may remain open. Glottal closure may be consistent or intermittent, complete or incomplete. Adynamic (nonvibrating) should be specified. The failure of glottic glossure may be due to local pathological or mural paralysis.

ACOUSTIC ANALYSIS

The various parameters of voice production that are analyzed in voice analysis are fundamental frequency, maximum phonation time, jitter, shimmer, noise to harmonic ratio and maximum phonation range.

1) FUNDAMENTAL FREQUENCY

The rate of vibration of vocal cord during the production of sustained vowels and while reading the passage. It is used for comparing intra and inter subject pitch levels. It depending upon the type of speech material used it can vary. Variability is less for sustained vowels when compare to reading passages.

2) MAXIMUM PHONATION TIME

It refers to the maximum duration that a particular vowel sounds can be sustained.

3) JITTER / FREQUENCY PERTURBATION

It is the measure of instability of the vocal cord during sustained Phonation otherwise, to the variation of fundamental frequency that present in all speakers to some degree and detected when the subject is attempting to produce a steady, sustained vowel. The frequency variations are the result of instability of the vocal fold cause frequency vibration. Normal speakers have a little amount of frequency perturbations, which varies according to age, sex and physical condition.

4) SHIMMER / AMPLITUDE PERTURBATION

The vocal cords exhibit slight variation of amplitude from one cycle to the next cycle during sustained vibration called amplitude perturbation

or “shimmer”. A small amount of shimmer in a Normal speakers which depends on sex and vowel used .

5) MAXIMUM PHONATION RANGE

It defined as range of lower frequency to higher frequency individual can produce. The person asked to sustain the tone for one full second without control the intensity and if he asked to sustained further on the production of sound then we can expect may be altered magnitude of the range obtained.

6) VOCAL INTENSITY

Vocal intensity of phonation during speech is depends on Various factors which includes intensity produced at glottis, the amount of lip opening , shape of vocal tract mean distance of microphone from the lips of the subject and physical and emotional factors.

7) HARMONIC TO NOISE RATIO

Voice is mixture of periodic and aperiodic noise. Whenever the noise component of voice increases and replaces the harmonic structure the quality of hoarseness is perceived and this is measured as harmonic to noise ratio.

VOICE HANDICAP INDEX:

It is the measure of the impairment of voice stated by a patient developed to determine the outcome pre and post operatively. Several type of questionnaires are available to self evaluate voice disability. Some of then are Llewellyn Thomas (1984) developed a linear analogue scale for self assessment of voice quality in laryngeal cancer.12

Smith et al (1994) developed a questionnaire regarding functional impact of voice disorders in various aspects of like, employment, risk factors, symptoms, and family histories. The other questionnaire are Voiss (Voice Symptom Scale) and VHI10.

The Voice handicap index used in this study was developed by Jacobson and Jhonson in 1997 which consists of set of questionnaire with three domains namely Functional, Emotional and Physical .Each Part has 10 questions each subset has 0 to 4 scores to the maximum of 120 and the minimum of 0. The minimum value for a normal person is less than 10.13

BENIGN VOCAL CORD LESIONS: PATHOGENESIS, PATHOLOGY AND CLINICAL FEATURES

Benign vocal mass lesions are lesions which has a different pathology. They include pathologies like vocal nodules, vocal polyps, vocal cysts and Reinke's oedema. The lesions having similar pathogenesis. The chief predisposing factor is Vocal abuse with additional factors like

Tobacco smoking, laryngoparyngeal reflux (LPR), environmental factors, hypothyroidism, allergy. The mechanism by which these factors produce lesions include, microtrauma; Excessive force causes damage of capillaries and changes in micro vascular circulation.

Temporary ischemia leading to increased permeability,lamina propria odema and hematoma. Organization followed by fibrosis and a nodule results at the edges.

Hammering effect of each vocal fold during Phonation causes direct compression.[16] Maximum trauma occurs at junction of anterior one third and posterior two third because this part having maximum vibration. Roughly it is the midpoint of membranous cord.

MICROSCOPIC PATHOLOGY

With the use of Heamotoxylin and Eosin stains the nodules and polyps look alike.Hemorrhagic event or increased vascular permeability leads to vocal polyp. Whereas Nodules produced by thickening of the epithelium or lamina propria.

Trauma of the vocal cord respond in Two Ways

TYPE ONE:

Trauma leads to lamina propria damage, associated with severe basement membrane zone injury, resulting an aggravated healing response

marked by fibronectin deposition. The extent and aggravation of basement membrane zone injury determined by thickness of the collagen type IV band. Repetitive injury, leads to aberrant healing and a fibroblastic response involving increased fibronectin deposition. Its excess presence probably does not contribute to efficient tissue vibration.

TYPE TWO

Absence of the structural glycoproteins and fibrous proteins would lead to a vocal fold with excessive propensity for deformability. The injury often seems to be confined to the lamina propria and apparently not contain fibroblastic response of tissue repair. This type seen more often in Reinkes oedema and some polyps[17].

INDIVIDUAL BENIGN VOCAL CORD LESIONS

NODULE OF VOCAL CORD

Most common vocal cord lesion in humans and commonly seen in people who speaks in high pitched voice like school teachers, Church preachers, and childrens, hence known as singer's nodules, teachers nodule and screamer's nodules in children. Hoarseness is the common symptom. It occurs at the junction of anterior one third and posterior two third free edge of the vocal cord. Nodules of Vocal Cord seen bilaterally and looks white, small, sessile, and often symmetric. Long standing polyps with contralateral contact changes will produce a same picture.

Oedema and vasodilatation are the initial event in the formation of nodule and this progress into hyalinization of the nodule and hyperplasia of epithelium. Histology shows, hyperkeratotic epithelium with parakeratosis. The subepithelial layer shows infiltration of irregular collagen fibers and fibroblasts.

Stroboscopy visualize pronounced vibration of the anterior segment of vocal cord with asymmetry and aperiodicity. Voice analysis pictures breathiness of voice with reduced loudness and increased jitter, shimmer and harmonic to noise ratio[19].

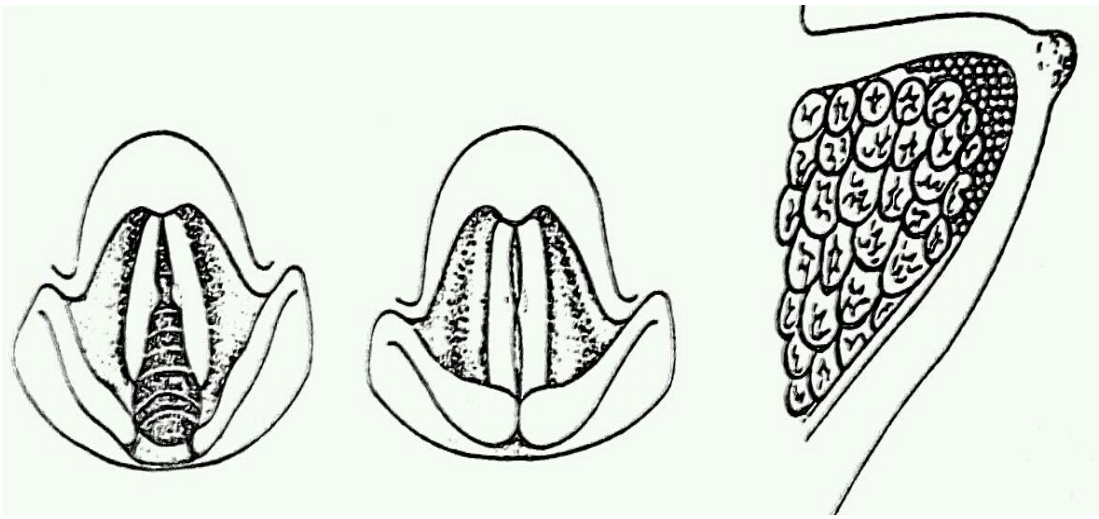


Fig 7-Vocal Nodule

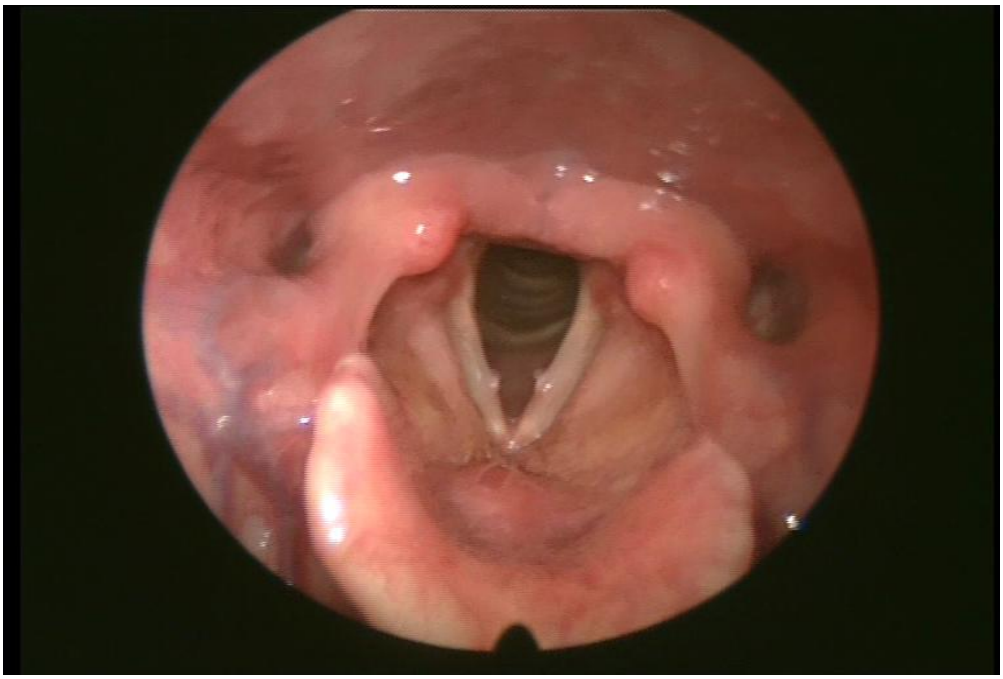


Fig 8:-B/L Vocal Nodule

VOCAL CORD CYSTS

Cysts of Vocal Cord mostly affect the adult population. Two types of cysts, mucous retentions cysts and epidermoid cysts. They are mainly unilocular and unilateral. Multilocular and bilateral, multiple vocal cord cysts of various sizes also occurred[20] Main differential diagnosis of Small sized vocal cord cysts are vocal nodules.

Mucous retention cysts are formed by mucous glands blockage seen at vocal cord under surface.They are lined by cuboidal or coloumnar epithelium looks like respiratory epithelium. Epidermoid cysts are formed by the epithelial ingrowth into the cord, by microtrauma or as a congenital anomely.The cavity is lined by keratinizing squamous epithelium and consists desquamated epithelium and cholesterol crystals[21].

Content of the cyst of mucous retention cysts are watery thin and mucoid and in epidermoid cysts it is inspissated debris. Stroboscopy of cysts pictures hyperkinetic pattern of mucosal wave in regions other than the area of cyst. Usually normal or reduced mucosal wave seen in cysts. Voice analysis shows the same picture as vocal nodule.

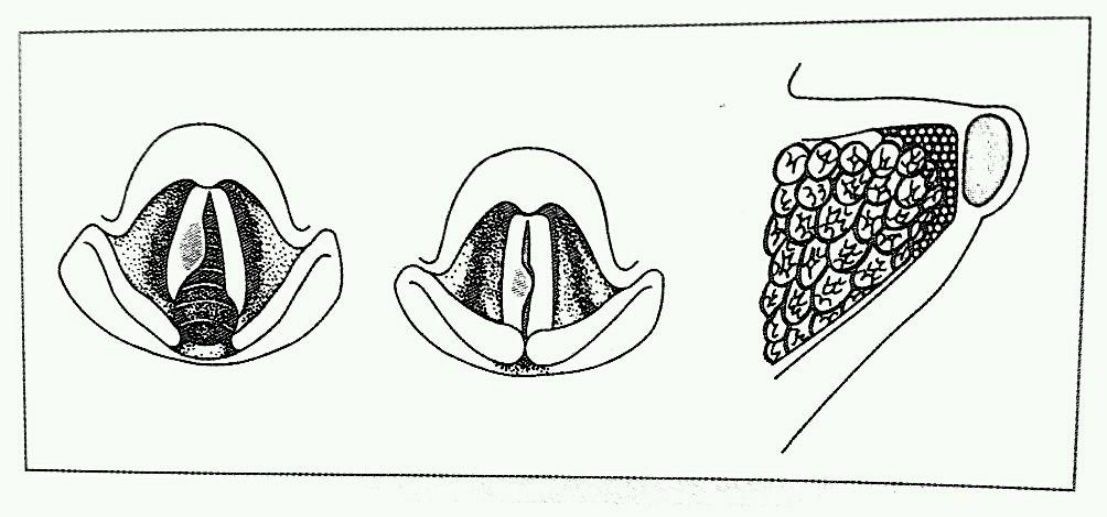


Fig 9-Vocal Cyst

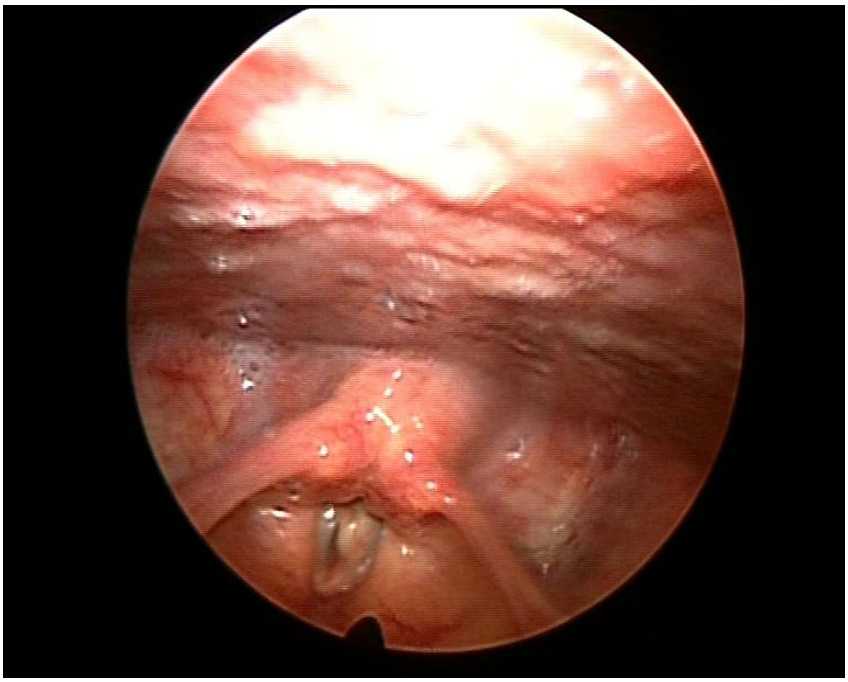


Fig 9A-Rt Vocal Cyst

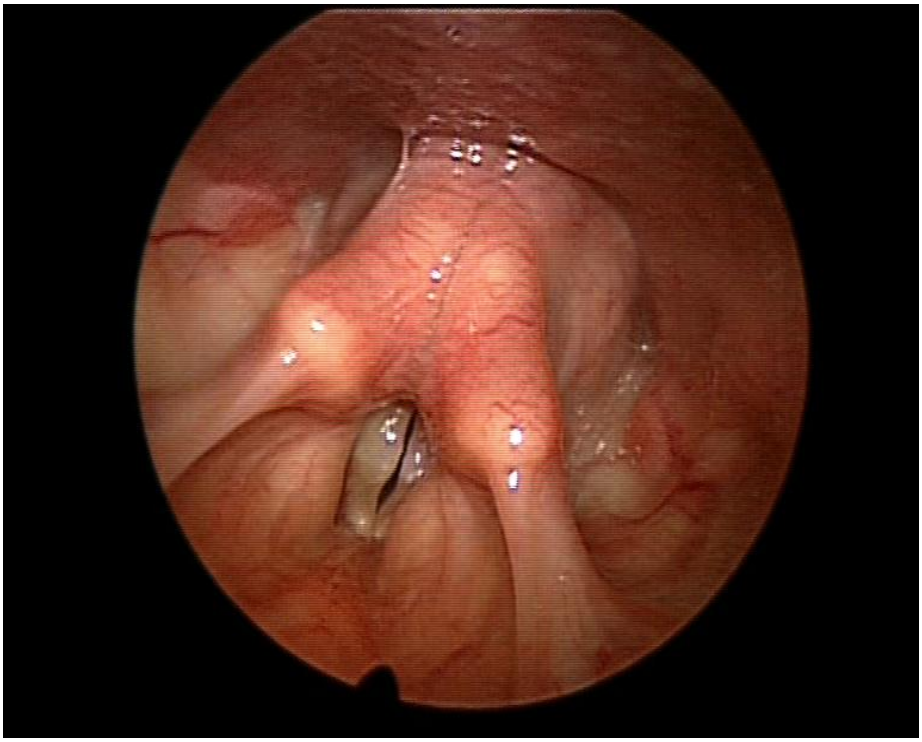


Fig 9B-Lt Vocal Cyst

VOCAL CORD POLYP

These are arise only from the vocal cord membranous part, usually close to the anterior commisure. Vocal polyps develop when there is an initial high subglottic pressure followed by abrupt reduction. This results in trauma to the basement membrane zone, leads to hyperemia and edema. Accumulation of oedema is focused at a particular point that part is ballooned and polyp is formed.22 Use of anti platelet drugs or anticoagulants can predispose to hemorrhagic polyps by Phonotrauma. Majority are males (70%) and Tobacco smokers (80%).

Histopathologically there are three types of polyps namely; gelatinous, telangiectatic and mixed type. Gelatinous polyps having very loose edematous stroma and sparse collagen, minimal fibrocytes, histiocytes and mast cells.

Telangiectatic polyps consists homogenous eosinophillic deposits and fibrin collections in the stroma. Labrynthine type of vascular channels are seen in stroma. The mixed type of polyp having features of both the gelatinous and telangiectatic type. These are the most common type of polyp seen.

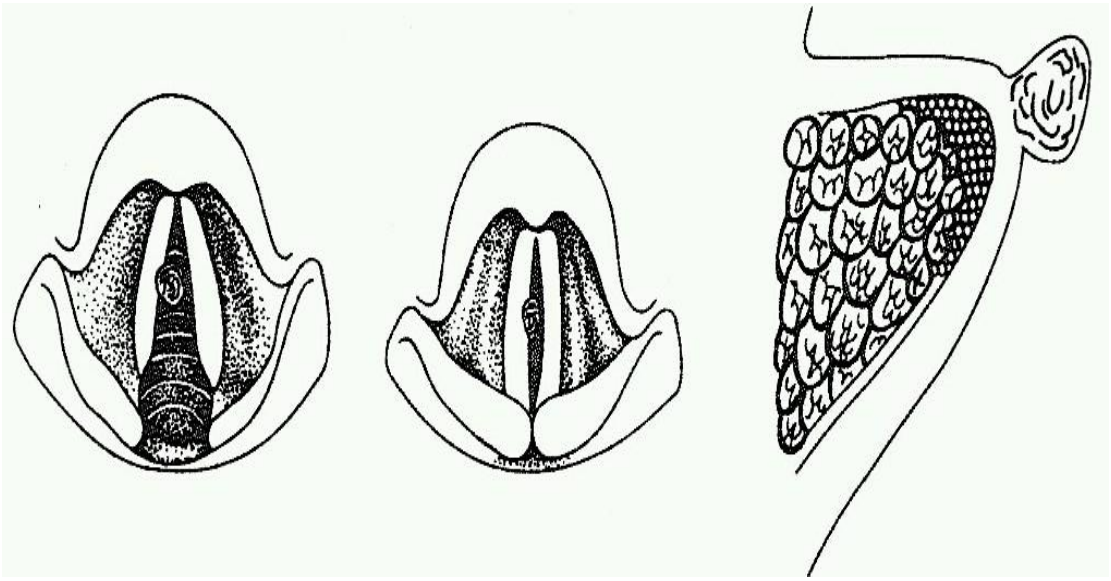


Fig 10-Vocal Polyp

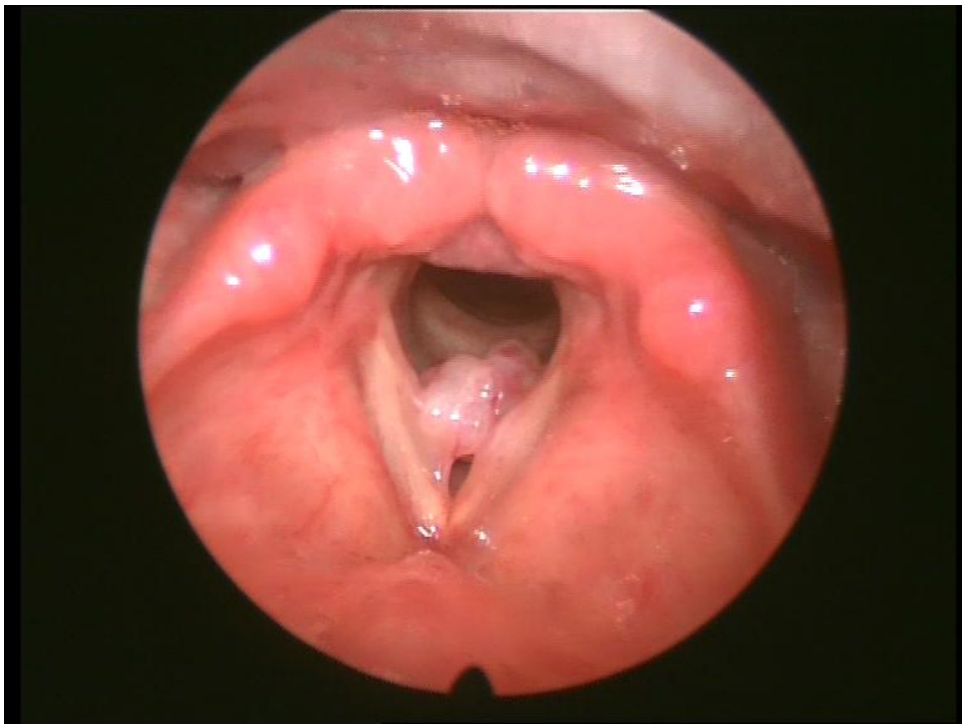


Fig 10A- Rt Vocal Polyp

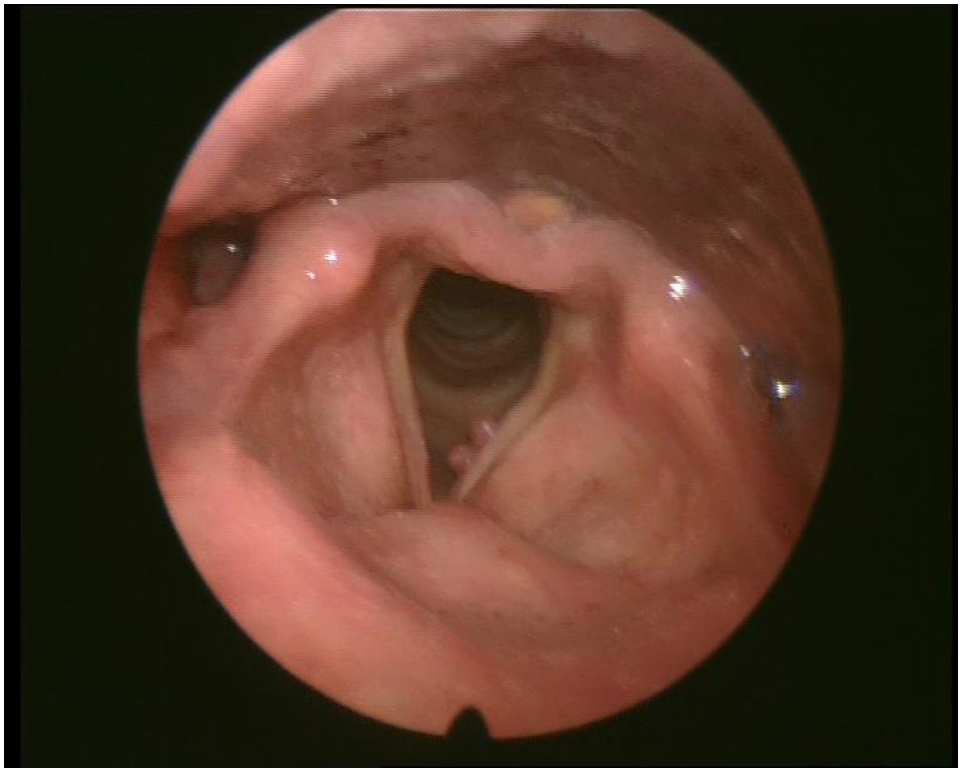


Fig 10B- Lt Vocal Polyp

Stroboscopy Shows adynamic segments, with aperiodicity and asymmetry. Voice analysis will pictures breathiness of voice with reduced loudness and with increased jitter, shimmer and harmonic to noise ratio.

REINKE'S OEDEMA

Also known as polypoidal degeneration, chronic polypoidal corditis, chronic edematous hypertrophy or chronic hypertrophic laryngitis[19]. Smoking is the major etiological factor. Fritzel in his retrospective study (1986) found that more than 95% of affected patients were smokers and Kleinsasser 98% were smokers20. Others include LPR and voice abuse. Abnormal increase of the glottic pressure with caustic exposure leads to increased vascular permeability and oedema of the vocal cord.

The association between thyroid dysfunction and Reinke's oedema has also been mentioned. Accumulation of fluid at the superficial lamina propria.

Histologically Reinke's oedema is divided to pale and livid types[23]. In pale type, limited, fusiform glazed swelling noted. The epithelium is thin and clear watery fluid collection is visible. Stromal cells and numerous intracytoplasmic granules are seen. In the livid type, the colour changes to yellow gray and fluid will be glue like consistency. Additionally multiple dilated ,irregular vessels seen.

Hoarseness main presenting symptom. Stroboscopy pictures that the body of the cord is not affected. Glottic closure is usually complete and the cord shows a fusiform, ballooned out appearance. Stroboscopy also shows loss of mucosal wave. Variable Loss of symmetry and the closure can be complete. Voice analysis pictures low fundamental frequency and high jitter and shimmer. Harmonic to noise ratio is increased.

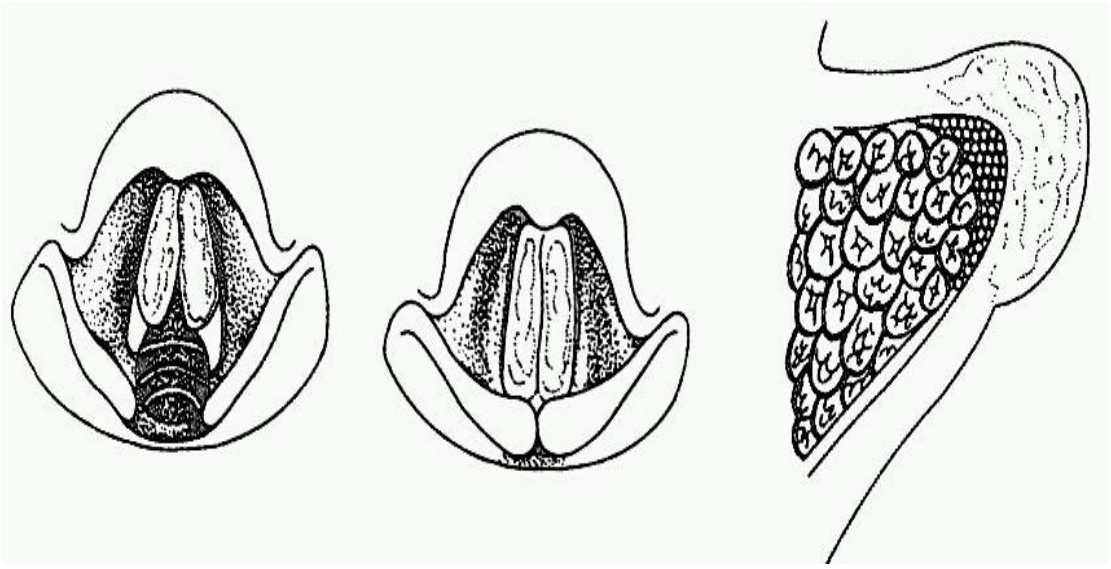


Fig 11-Reinke's edema

MATERIAL AND METHODS

MATERIALS AND METHODS

MATERIALS

STUDY DESIGN

A prospective cohort study of 38 patients with benign vocal cord lesions, were included in the study.

SETTINGS :

Department of ENT and Head and Neck Surgery, Govt Stanley Medical College and Hospital, Multi Speciality Teaching Institute Chennai-1

PATIENTS :

INCLUSION CRITERIA :

- Benign looking vocal cord lesion patients
- Age 12 years above
- On Rigid fiberoptic endoscopy / indirect laryngoscopic examination the vocal cords will be Freely mobile.

EXCLUSION CRITERIA:

- Patients with malignant looking lesions.
- Patients suffering from Respiratory distress
- Patient with ischemic/Coronary heart diseases.
- Inability of patients to turn for follow up at six weeks.

METHODOLOGY :

Patients included in this study after fulfilling the inclusion and exclusion criteria defined in this study and after getting valid consent. . Each patient with benign vocal cord mass lesion underwent pre and post operative three procedures like, Video laryngoscopy, stroboscopy and voice analysis.

VIDEO LARYNGOSTROBOSCOPY:

Fiberoptic laryngoscopy demonstrating laryngeal pathology and provides an excellent view of the larynx, particularly suited for patients who are unco-operative for indirect laryngoscopy.

PROCEDURE:

The patient sat and must facing the examiner. Before starting this procedure Each patient was sprayed with a mixture of 4% or 10% lignocaine applied at oropharyngeal mucosa. A 4 mm rigid Endoscope was passed per orally under direct control and vision.

The visualized areas were the, oropharynx and the larynx. The larynx examined in detail regarding the size, shape of vocal cord lesion, presence of hemorrhage and pedunculated or sessile lesion. The contralateral vocal cord was assessed.Cordal mobility was also assessed.

VIDEO STROBOSCOPIC UNIT

Components:-

1. **Stroboscopic Unit**

a) **Light Source**

b) **Microphone**

2. **Video Camera**

3. **Endoscope**

4. **Videorecorder**

STROBOSCOPY

Fig 12-Stroboscopy Unit

Fig 12A- MONITOR

Fig 12B- CAMERA UNIT

Fig 12C-LIGHT SOURCE

Fig 12D-DIGITAL PRINTER

Fig. 12E-FOOT PEDAL

Fig 12 F- UPS

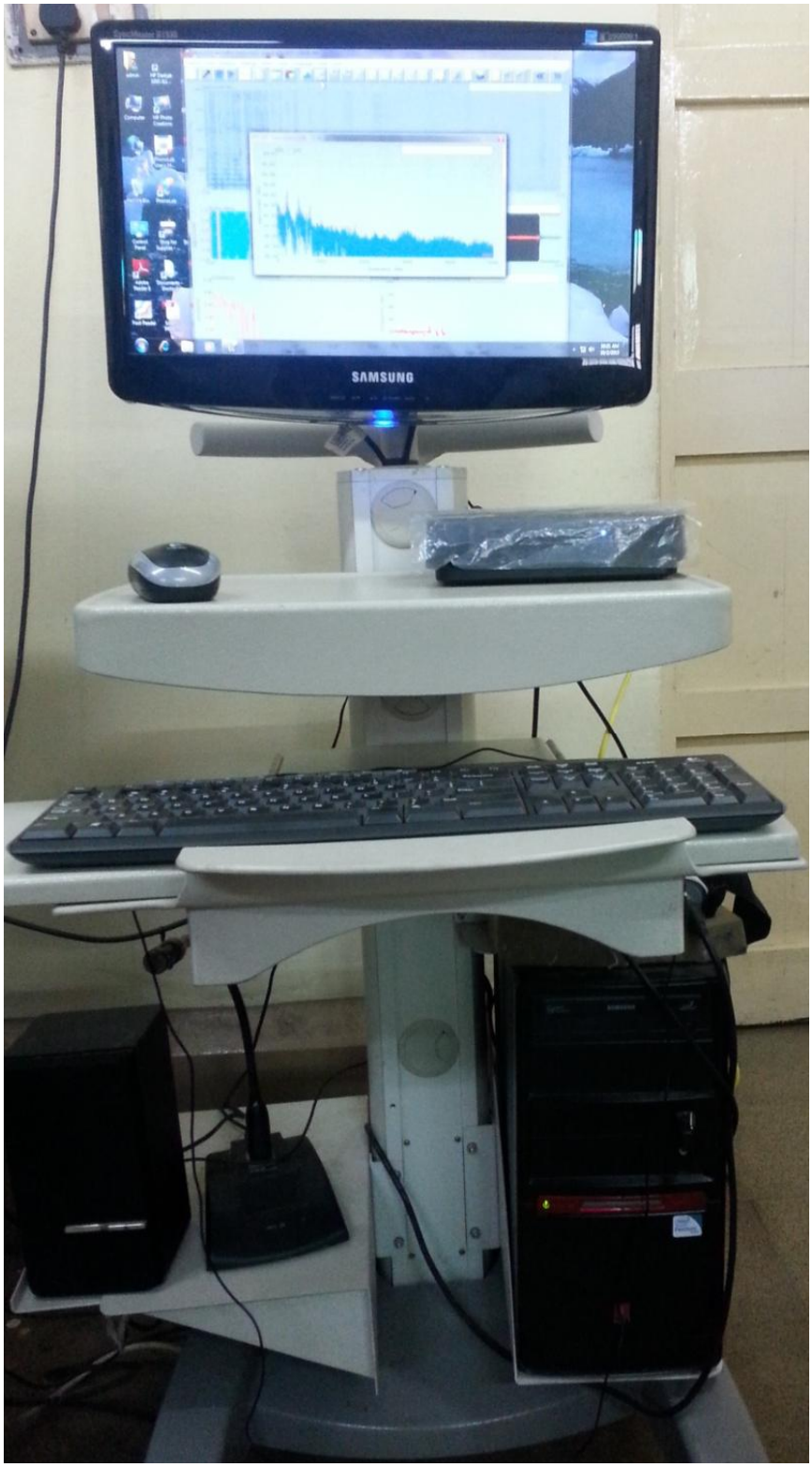


Fig 13-PHONOLAB-ECLERIS VERSON 03.02

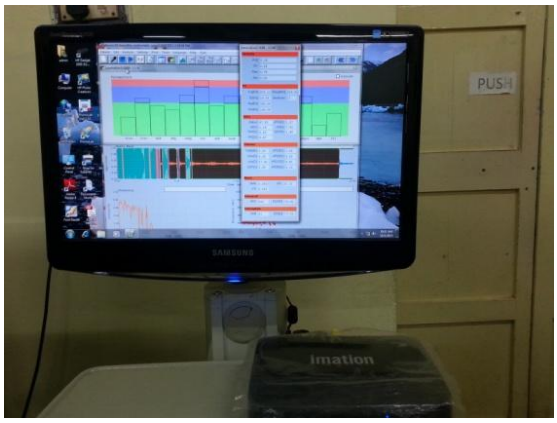


Fig 13A-MONITOR **Fig. 13B-PRINCIPAL UNIT**

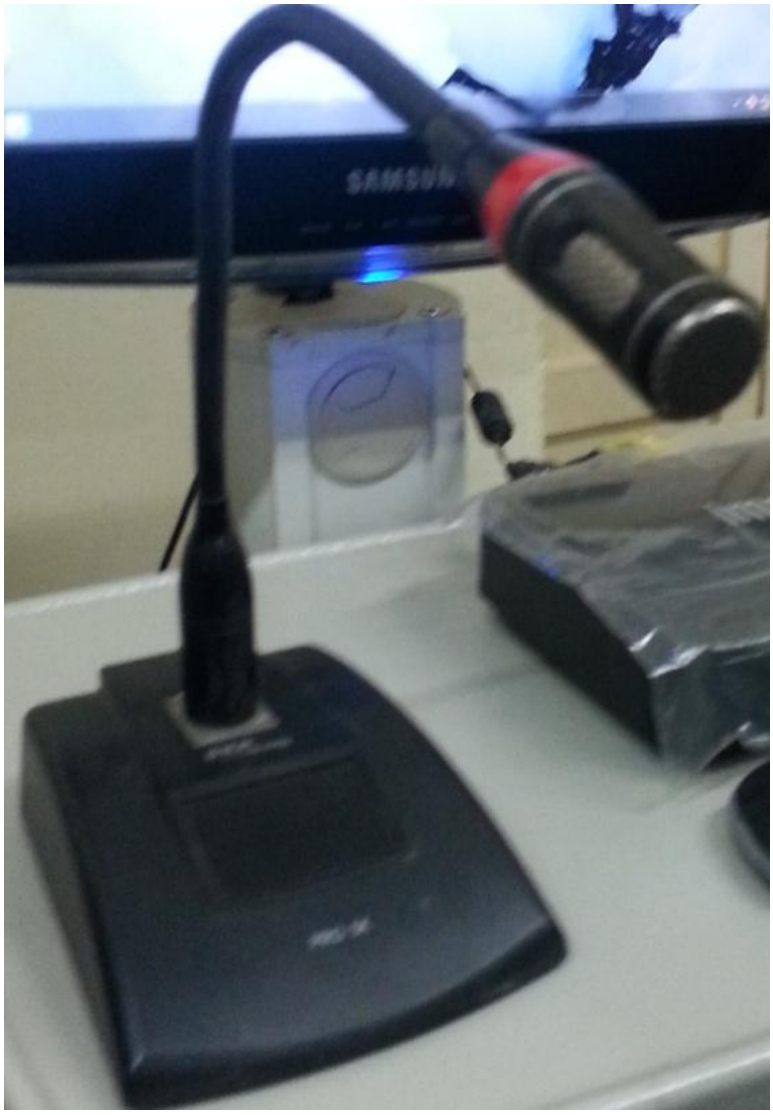


Fig 13 C- MICROPHONE

Stroboscopy is a procedure which allows routine slow motion examination using a laryngeal stroboscope, a 70 degree Hopkins telescope. The procedure was performed after rigid video laryngoscopy. The procedure was explained to the patient in detail regarding the need to keep the mouth open and avoid swallowing during the test. Local anesthetic was provided to the larynx with 10% lignocaine spray. After few minutes the patient was asked to open the mouth wide and protrude the tongue. The tongue was held by the examiner with gauze piece, simultaneously supporting the jaw at its upper part. The telescope was introduced into the oropharynx to visualize the glottis after using antifogging solution. The patient was asked to phonate long "eee" to see the cords in motion. While the patient was phonating the stroboscopy pedal was pressed so as to produce pulsed light in accordance to the patient's fundamental frequency.

The patient underwent for stroboscopy which was done by using a Karl Storz stroboscope. The output picture and sound was captured into a computer monitor using a capture card without compression and analyzed later.

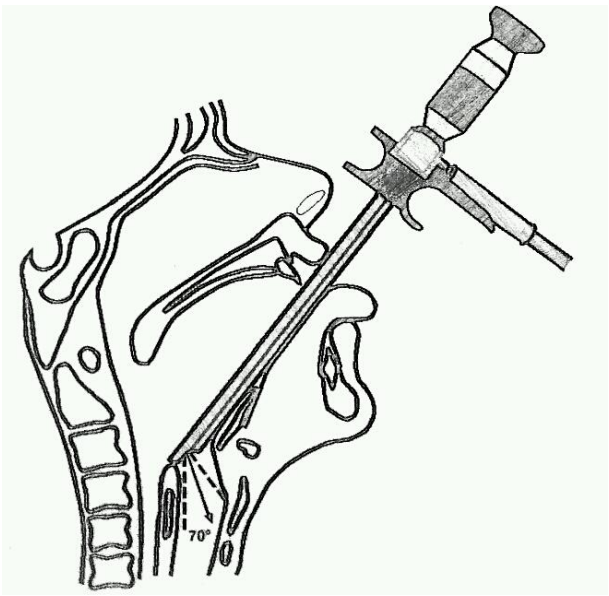


Fig 14-Endoscopic Procedure

The stroboscopy picture was analyzed to note:

1. Symmetry (symmetry of movement and approximation of vocal cords)

2. Mucosal wave (pattern of light traveling on the vocal cord)

3. Glottic closure (completeness of glottic closure)

NORMAL MUCOSAL WAVE PATTERN SEQUENCE

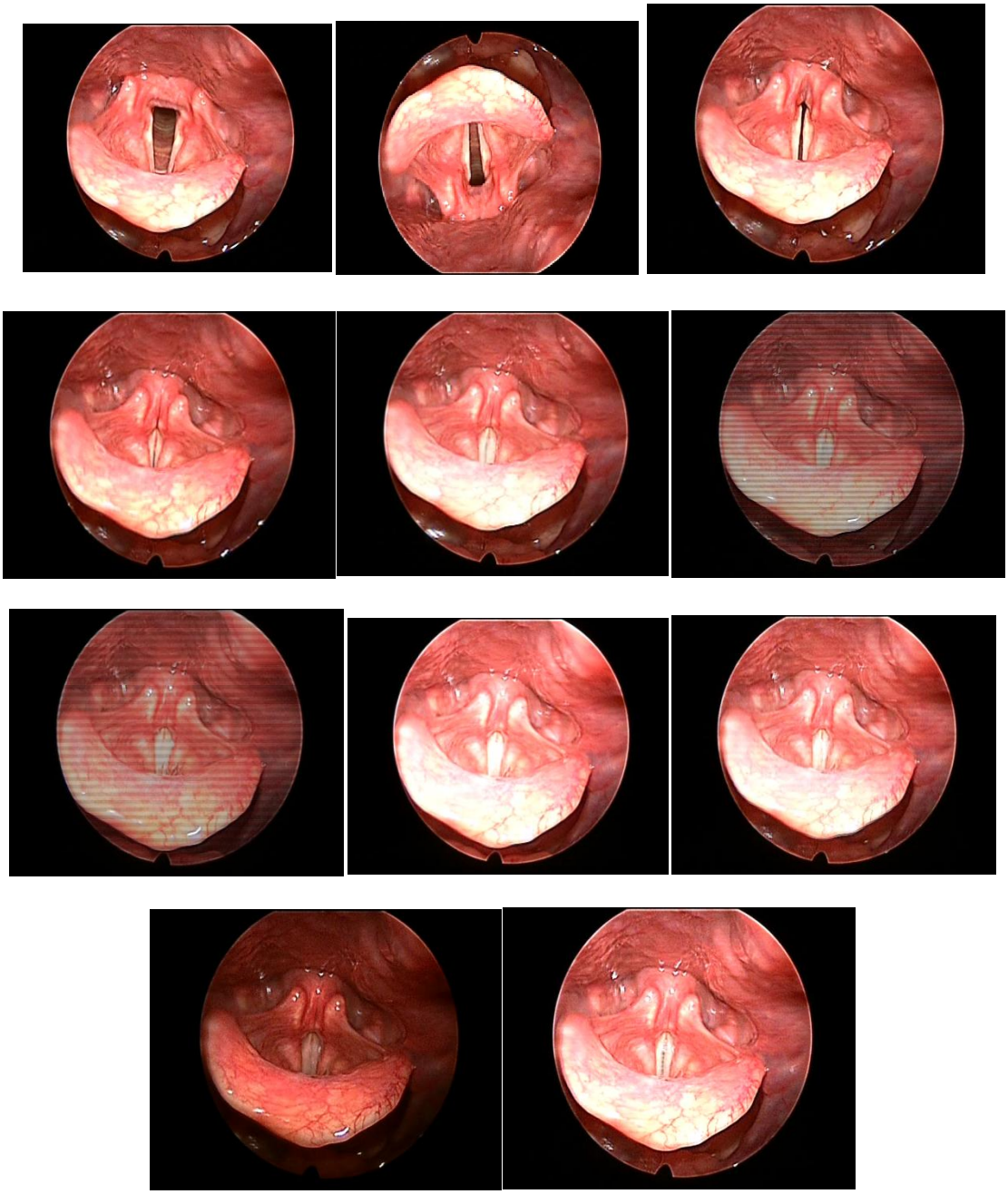


Fig 15- NORMAL MUCOSAL WAVE PATTERN SEQUENCE

VOICE HANDICAP INDEX

Voice handicap questionnaire have been designed for assessment of patients with voice disorders. Here questionnaire developed by "Jacobson et al13" was used. All patients administered the questionnaire and a measure called the voice handicap index was calculated. The measurer refers to the total sum obtained (minimum of '0' and maximum of '120') when the voice handicap score is administered.

VOICE ANALYSIS

The next step is voice analysis. Each patient was taken to a sound proof room to record voice using a low impedance commercial microphone and asked to phonate in low and comfortable voices. Each of these vowel sounds were voiced for at least of 15 to 20 seconds for low and comfortable intensity. Speech is recorded in intensity comfortable for the patient.

Only a good quality continuous signal was selected and used for analysis. Speech sound was recorded by asking the patient to count numbers slowly and clearly. The recorded voices are stored in computer for analysis. Voice analysis was performed on PHONOLAB software version 03.02.08 ECLERIS.

"PHONOLAB" is an open source freeware developed specifically keeping in mind scientific analysis of the sound signals recorded in "wav" format. This software is freely available in internet (freeware). This is an

opens source code; which means that the program can be altered to fit to individual necessity.

The parameters that were observed on voice analysis were

1. Fundamental frequency (vocal cord vibrating frequency)

2. Standard deviation of fundamental frequency.

3. Jitter (fundamental frequency variation)

4. Shimmer (one cycle to cycle amplititude variation)

5. Harmonics to noise ratio (amount of noise in voice)

SURGERY

After the complete preoperative workup, under general anesthesia all patients underwent micro laryngeal surgery using a suspension laryngoscope. The surgeon was not the same for all the patients. In surgery, the lesions were completely excised to the satisfaction of the surgeon and an independent observer.

Post operatively, patients were advised strict voice rest for a period of fourteen days. Advice regarding the usage of voice and the do's and don'ts following surgery were given. Contact numbers of all patients were noted.

VOCALNODULE

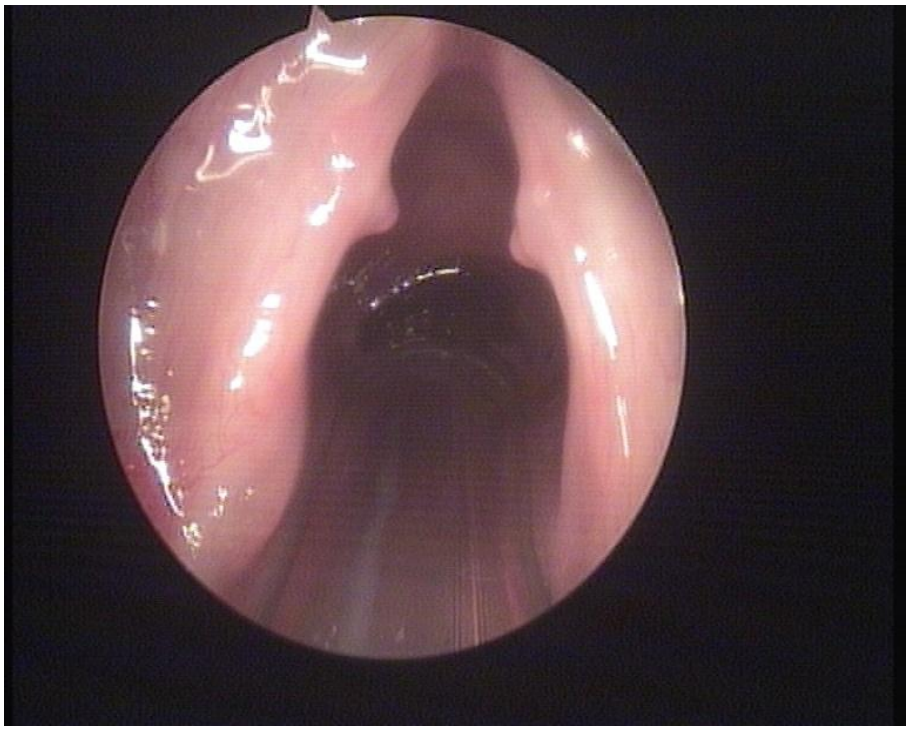


Fig 16-Pre-OP Vocal Nodule

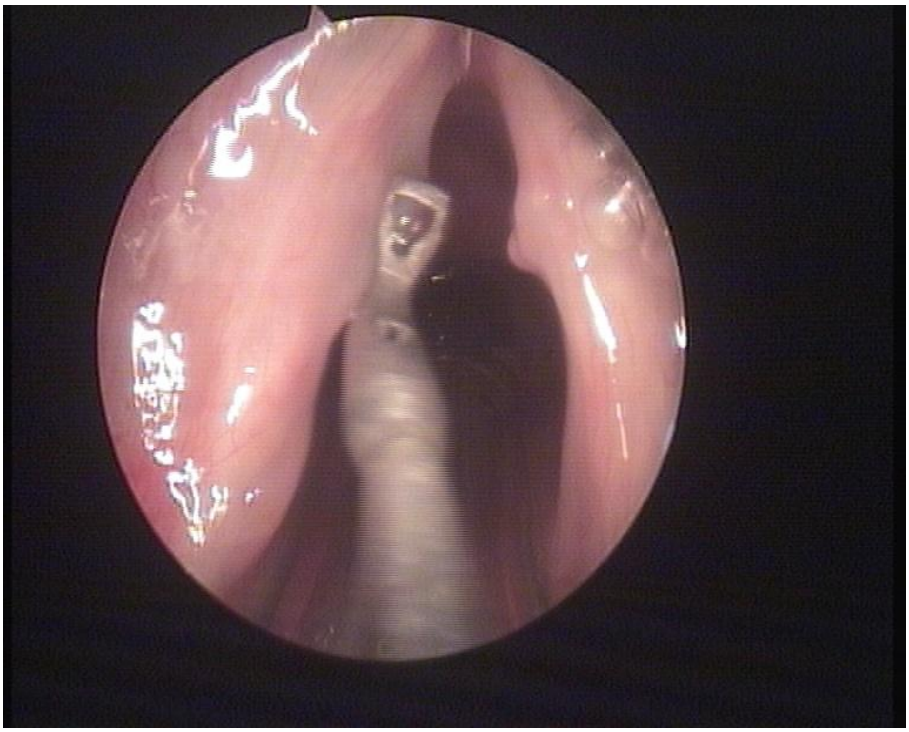


Fig 16A-Intra-OP Rt Vocal Nodule Removal

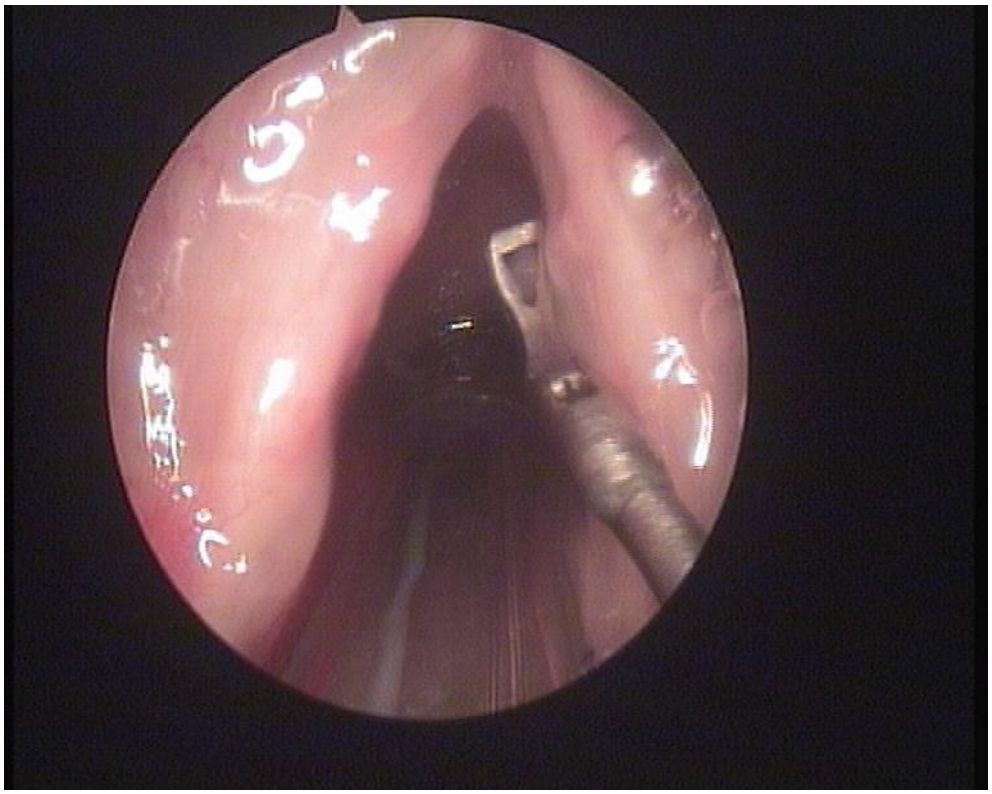


Fig 16B-Intra Op Lt Vocal Cord Nodule Removal

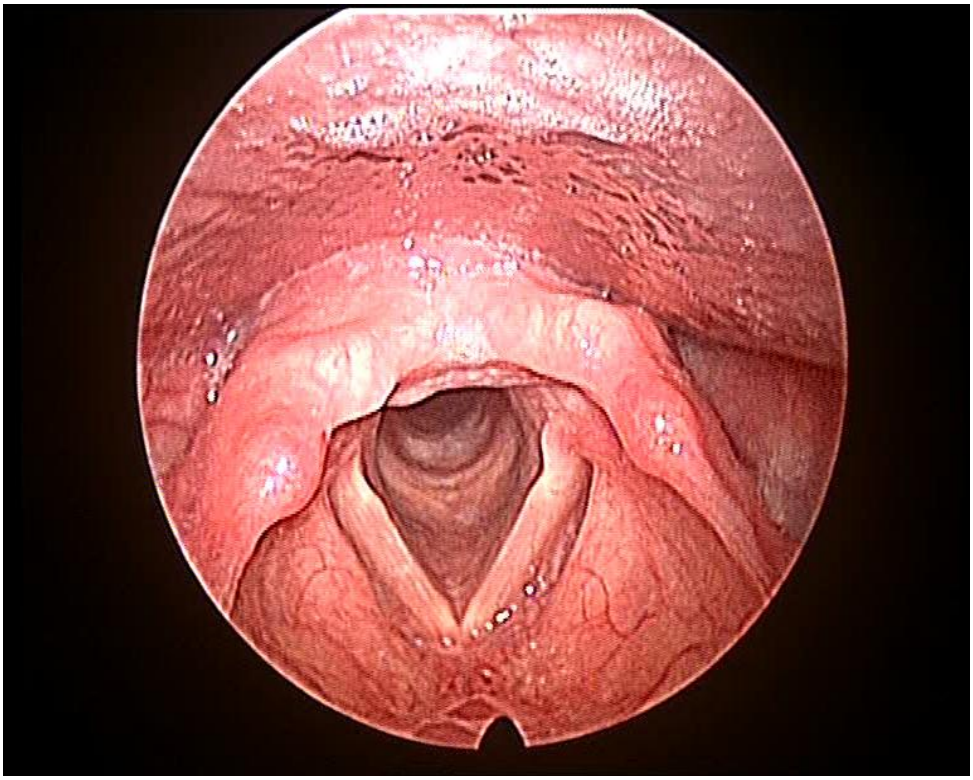


Fig 16C-Post-OP Vocal Cord Status

VOCAL POLYP

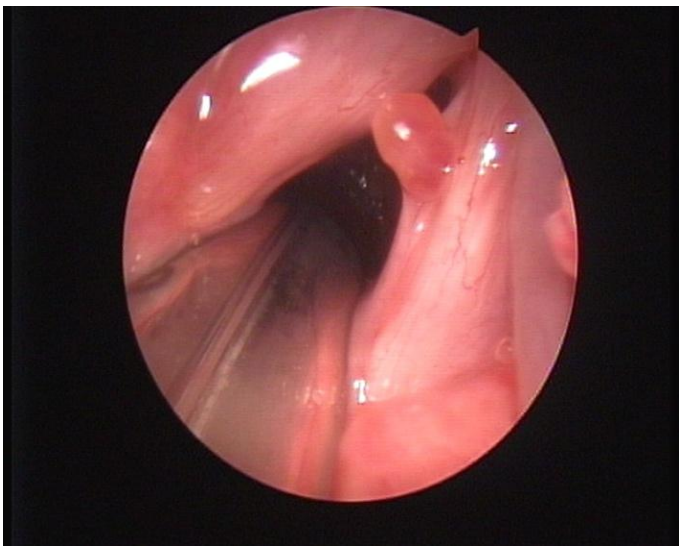


Fig 17-PRE-OP Vocal Polyp Rt

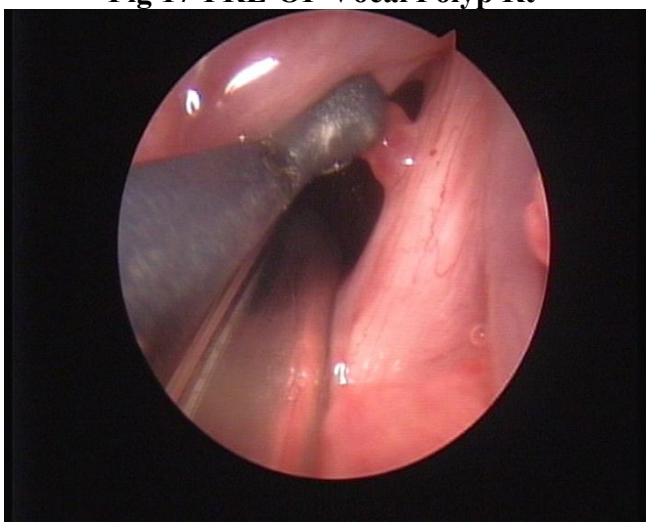


Fig 17 A-INTRA OP Rt Vocal Polyp Removal

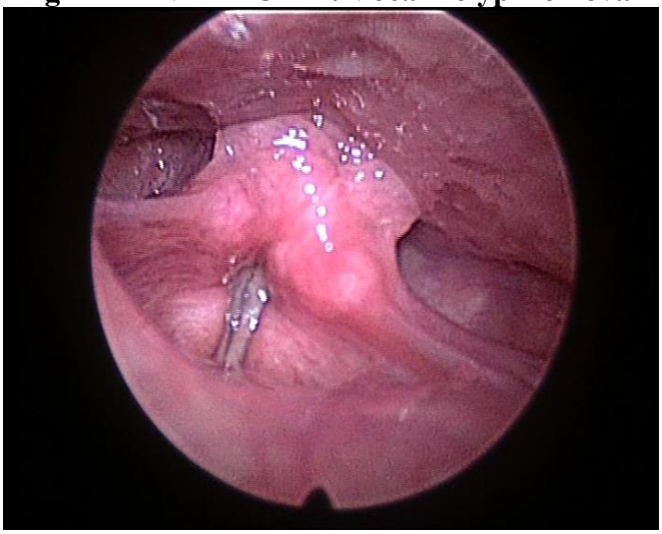


Fig 17B-POST OP Vocal Cord Status

VOCALCYST

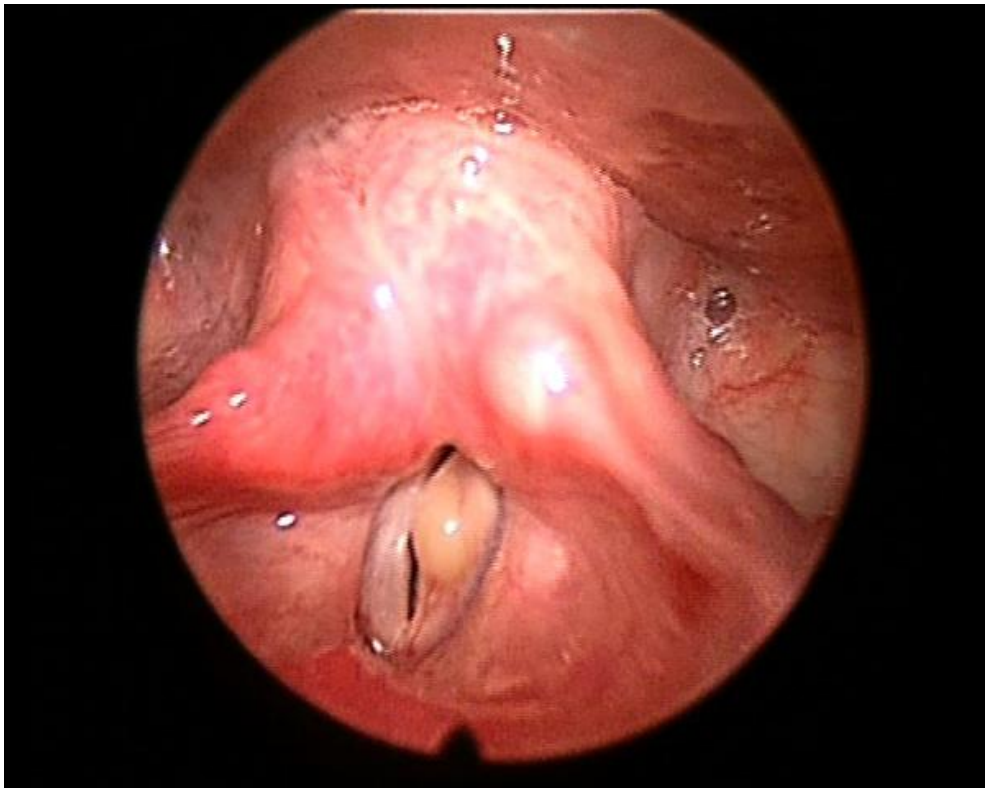


Fig 18-PRE OP Vocal Cyst

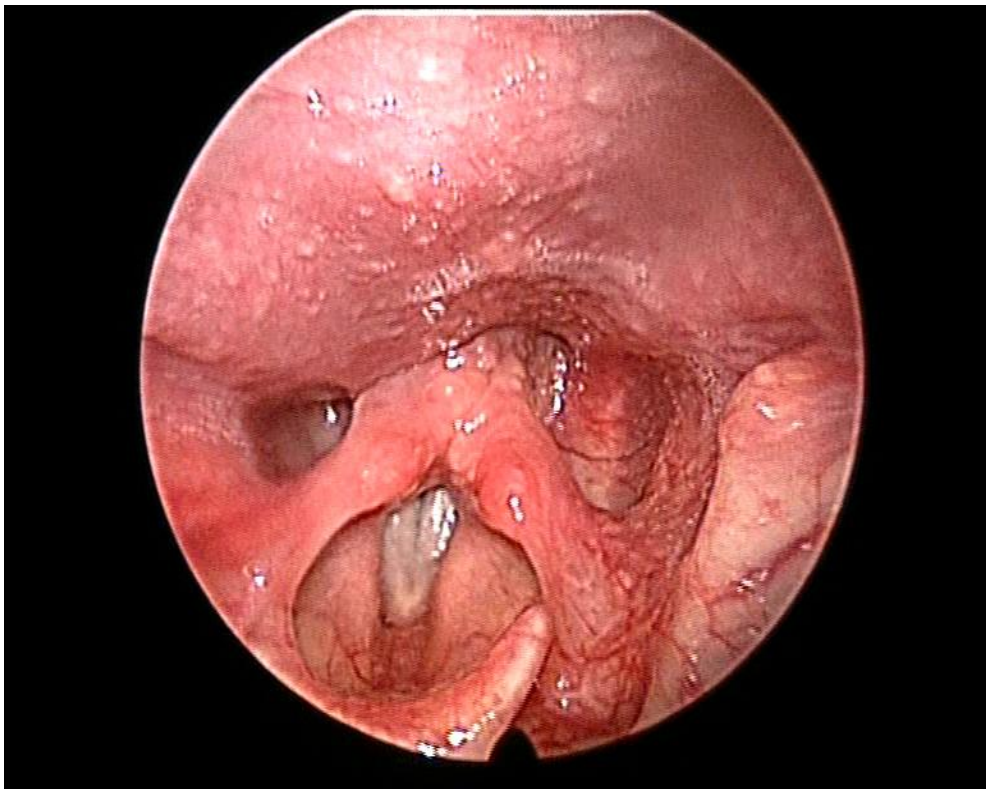


Fig 18A-POST OP Vocal Cord Status

VOCAL POLYP(ANGIOMATOUS)

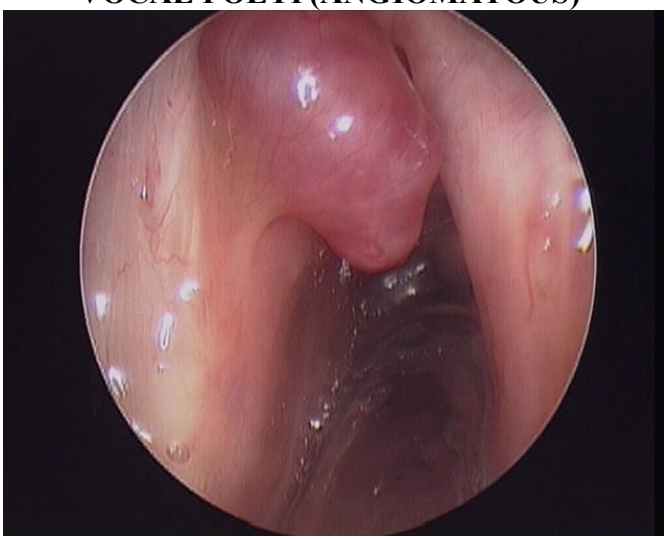


Fig 19-PRE-OP Vocal Cord Polyp

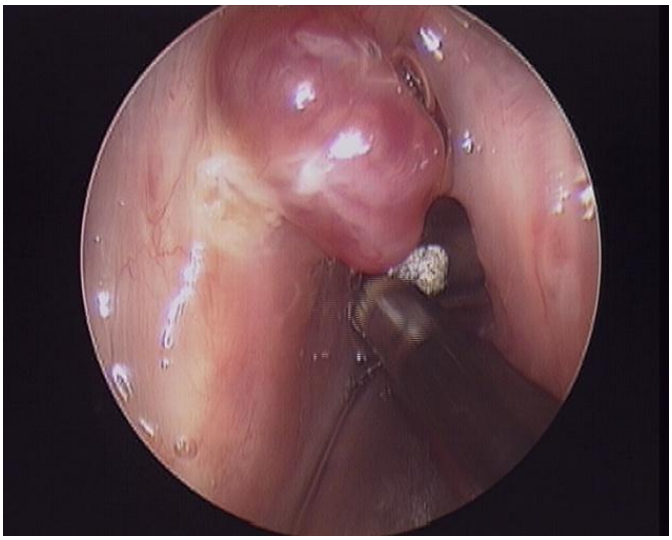


Fig 19 A-INTRA OP(COBLATION) Polyp Removal

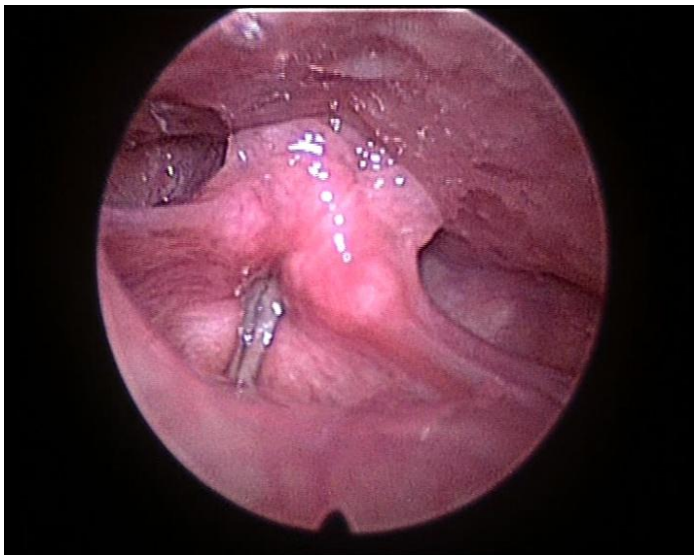


Fig 19 B-Post Op Vocal Cord Status

POST OPERATIVE REVIEW

All the operated patients were asked to come for review after 6 weeks(42 days) following surgery. On review,

1. Stroboscopy
2. Voice analysis
3. Voice handicap index questionnaire

The methodology used for each patient was similar to that used preoperatively.

RESULTS

DEMOGRAPHIC CHARACTERISTICS

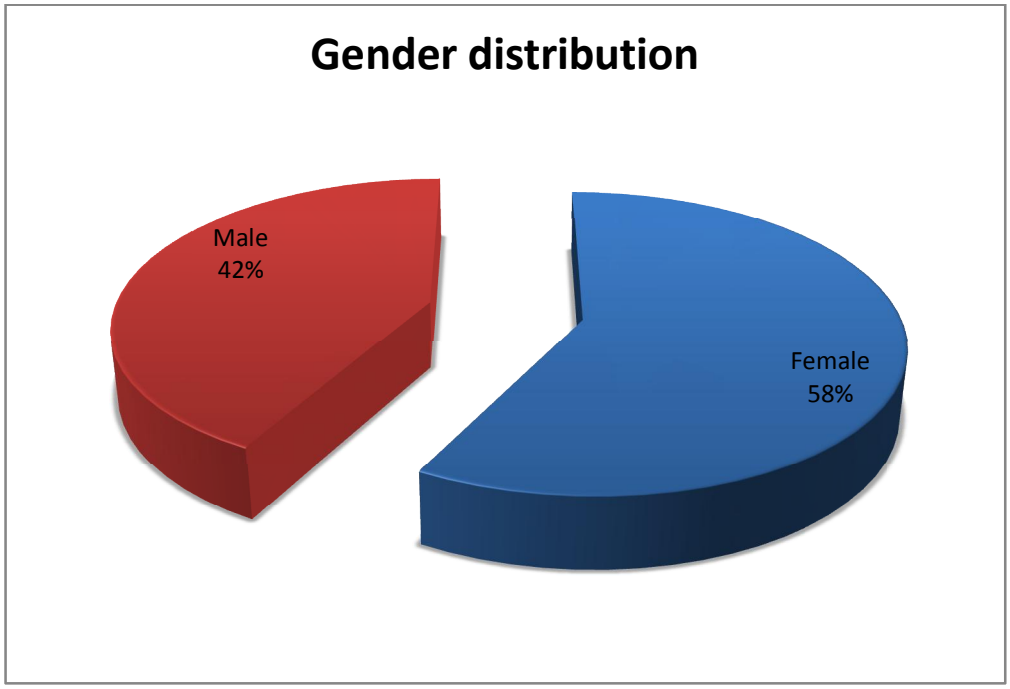
AGE DISTRIBUTION:

In the group of 38 patients the mean age was 36.47 . The youngest subject was 13 years and oldest 62 years old.

RESULTS AND OBSERVATION

SEX DISTRIBUTION:

A total of 38 patients were enrolled in this study. A Female preponderance 22 was seen.



GEOGRAPHIC DISTRIBUTION:

The majority of my patients came from Chennai , while the outside to Chennai city consisted of 0.

DURATION OF COMPLAINT:

Among the 38 patients; a mean duration was 12.44 months. The range of duration of complaint was 02 to 48 months.

ASSOCIATED HABITS AND HISTORY

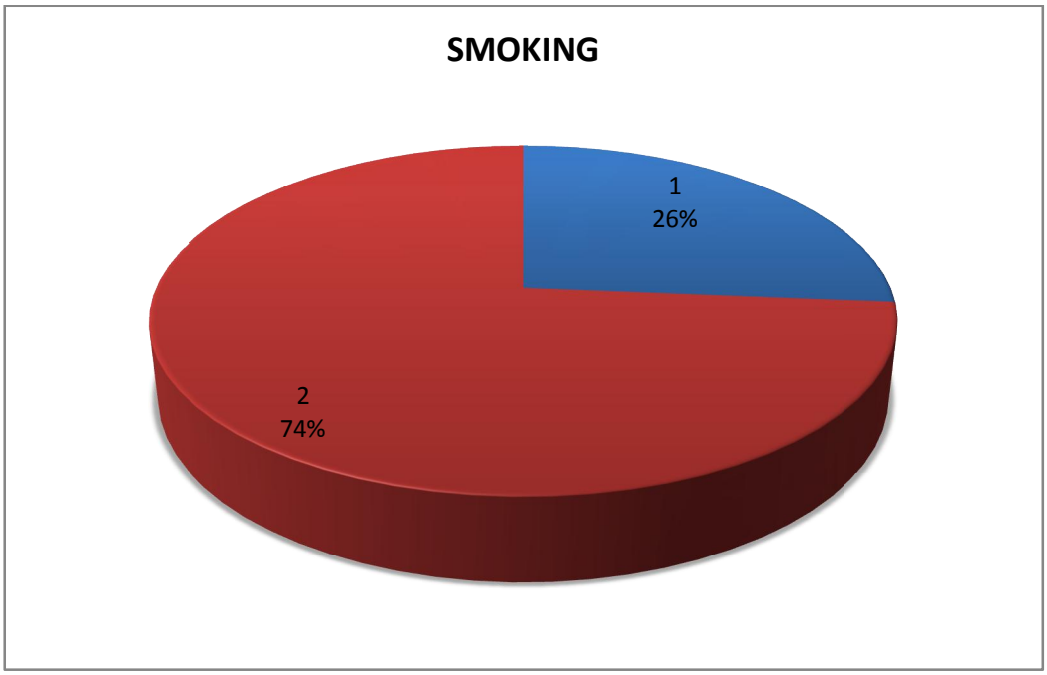
VOICE DEMAND AND VOICE ABUSE

In the group of 38 patients, there was one professional voice (grade I) (n=1) user as preacher. On categorizing them according to the voice demands, there were professional voice users (grade II) (n=03) non professional voice users (grade III)(n=07) and non professional non voice users (grade IV) (n=27).

Voice abuse is one of the leading known etiological factors for benign vocal cord lesions. In this study, we found that almost all patients with history of voice abuse.

SMOKING

Among the 38 patients 74 % were non smokers and 26 % were smokers. All the smokers were males.

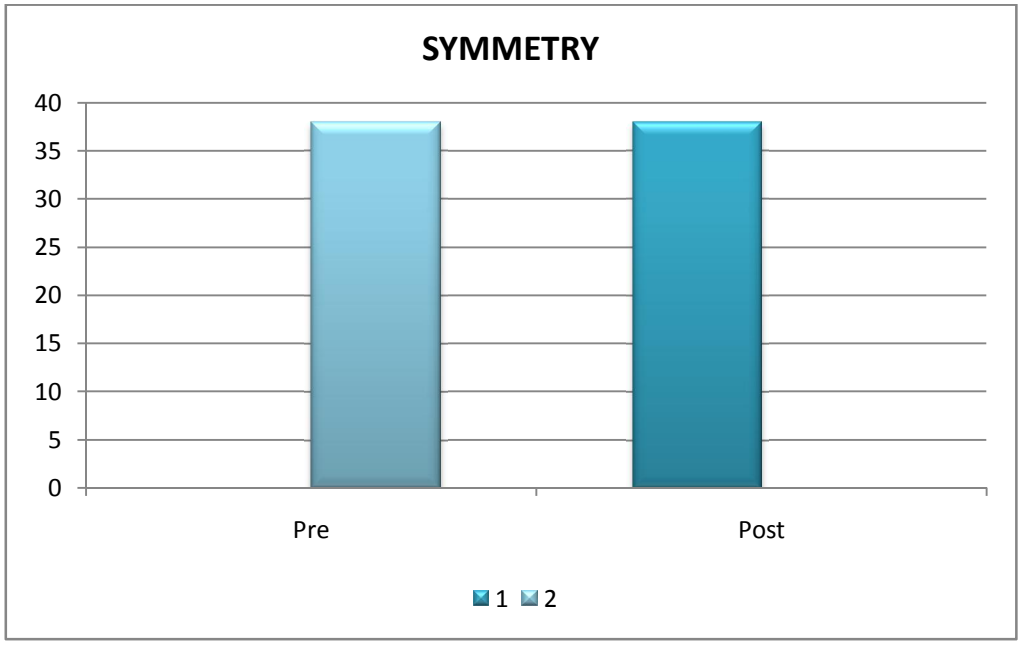


STROBOSCOPIC PARAMETERS

Pre operative analysis (Table)

SYMMETRY

Almost All patients with vocal cord lesions had Asymmetry .



MUCOSAL WAVE

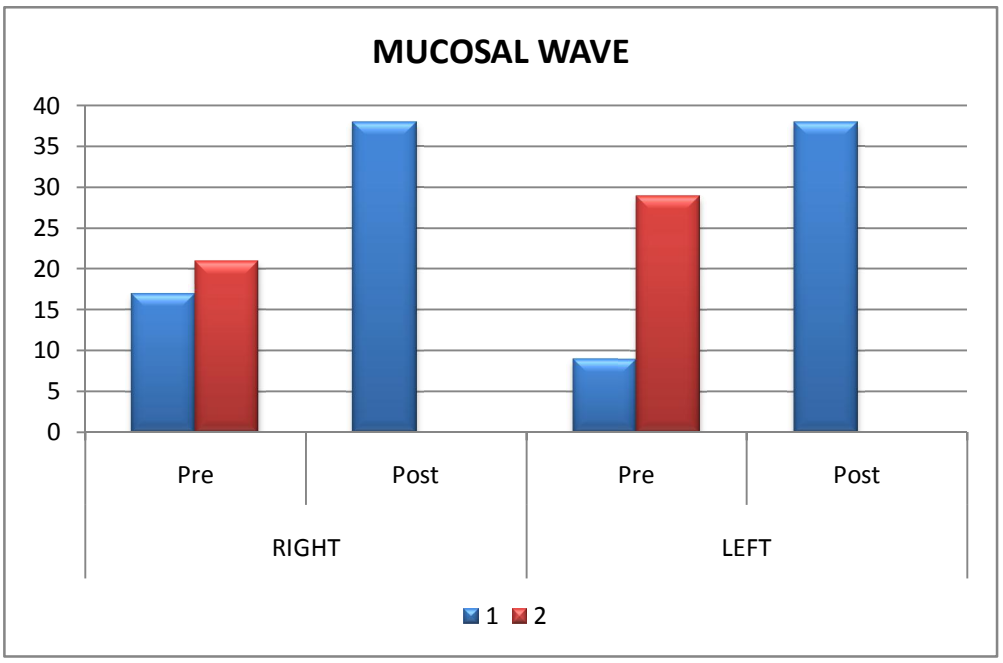
Right and left patten were analyzed Individually.

MUCOSAL WAVE (RIGHT)

Nearly 55.26 % of patients was found with absent mucosal wave on right vocal cord.

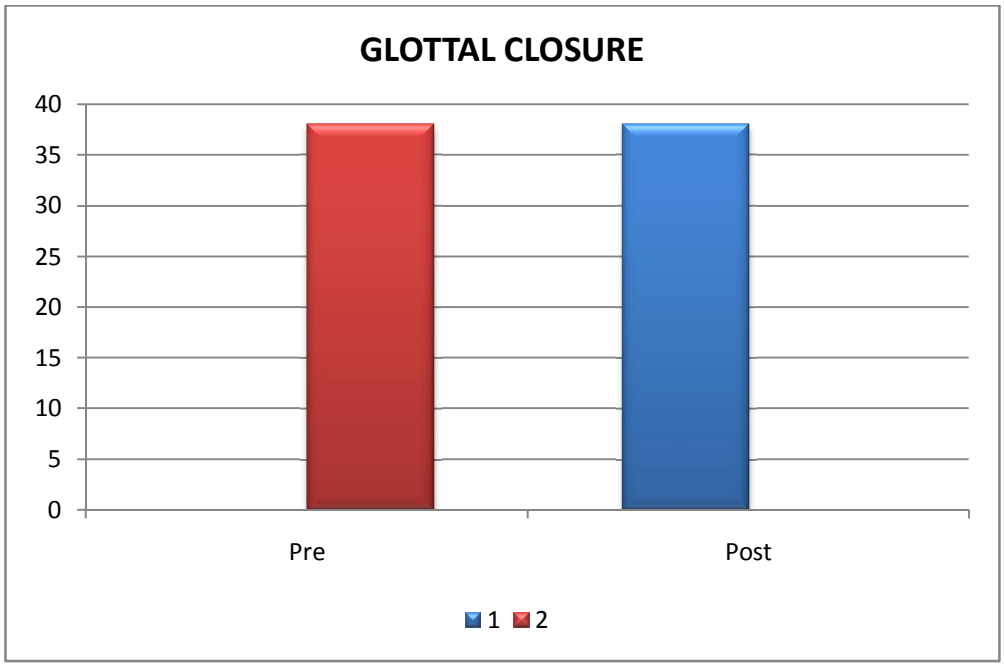
MUCOSAL WAVE (LEFT)

Among 38 patients only 76.31 % of patients sures absence mucosal wave on the left.



GLOTTAL CLOSURE

Incomplete closure of the glottal chink were noted in all the patients who were examined.



Analysis of GLOTTIC CLOSURE(Vocal Nodule)

	Complete	Hourglass	Irregular	Posterior chink
Present	0	14 (95%)	0	2 (5%)
Absent	16 (100%)	2 (5%)	0	14 (95%)

TABLE

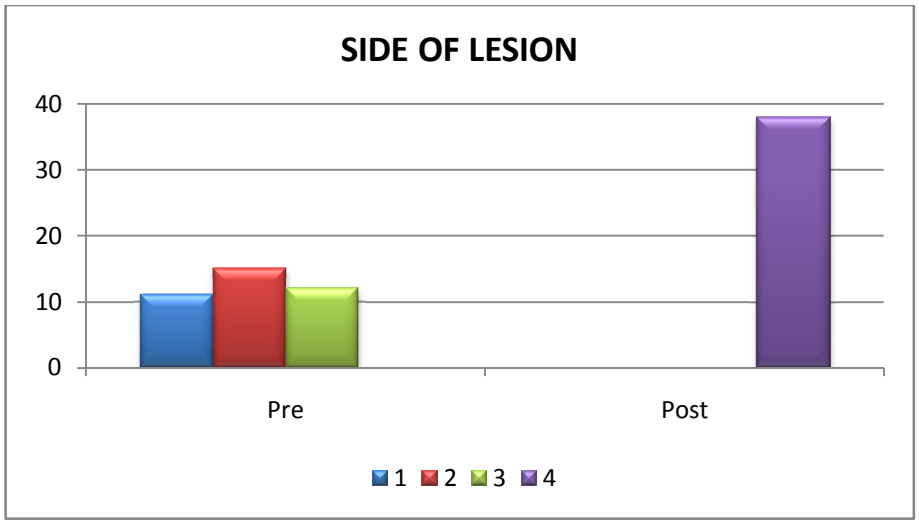
Pre operative stroboscopic analysis (n=38)

`	**Present**	**Absent**
Symmetry	0	38
Mucosal wave (right)	17	21
Mucosal wave (left)	9	29
Glottic closure	0	38

Table 5-Pre Operative Stroboscopic analysis

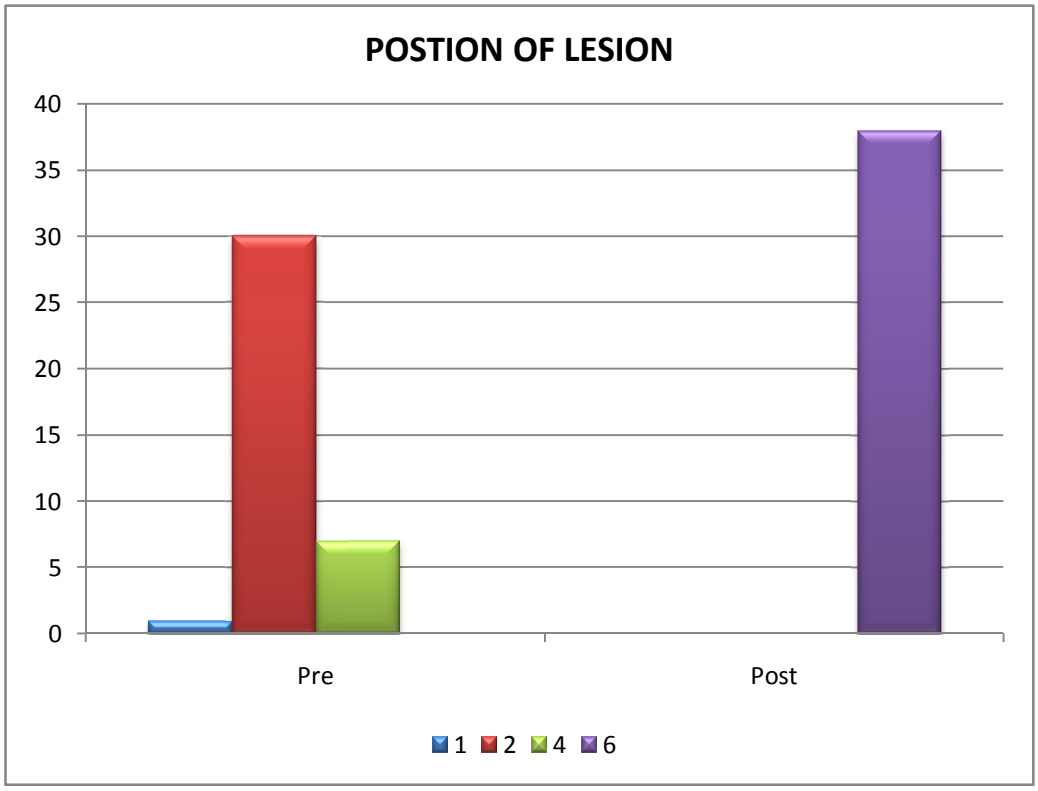
VOCAL CORD LESIONS FOR SIDE AND SITE

Among 38 patients 28.9 % involved right cord and 31.6 % add lesion on both vocal cords.Left side involvement were found in 39.5 %. Glottic closure pattern were different in concern with size of polyps. Majority were hour glass type of closure.



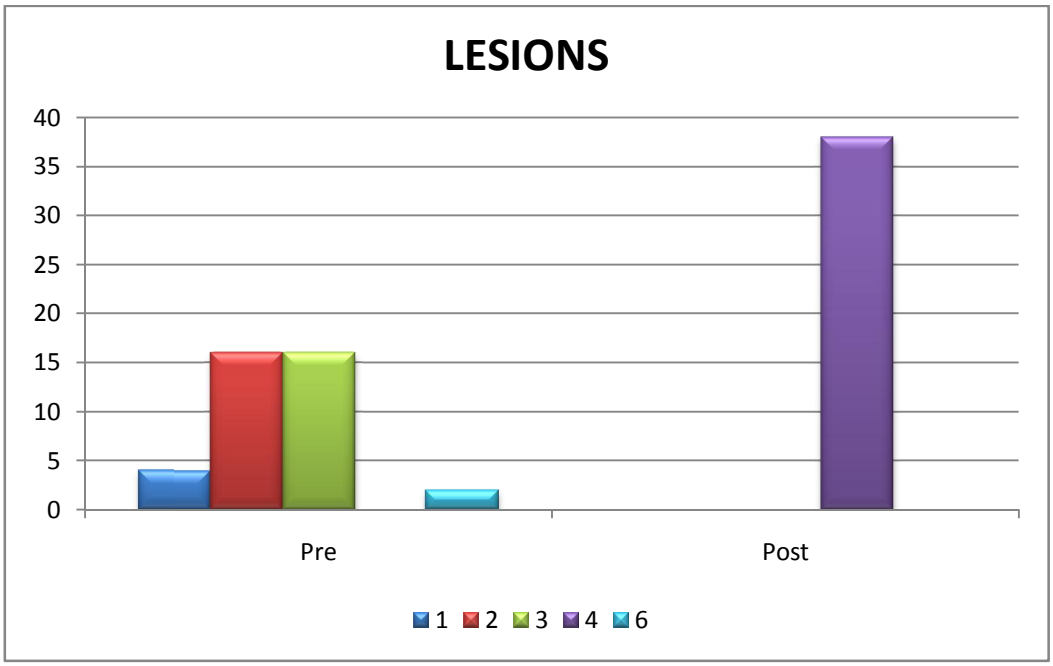
POSITION OF LESION

The majority of them had left cord lesions (39.5 %) at the junction of anterior and middle third of cord (42.10 %) and Middle third lesions (42.10%) were more frequent than the anterior third lesions (15.78 %)



TYPES OF LESIONS

The majority of patients had vocal nodules and cysts at equal number and percentage 16 (42.1%)Vocal polyp for 6 (15.8%) Patients.



POST OPERATIVE ANALYSIS:

SYMMETRY:

Glottics post operative symmetry have risen from 0 to 100 in the patient.

MUCOSAL WAVE RIGHT:

The Mucosal wave right pattern considerably increases 55 % to 95 %.

MUCOSAL WAVE LEFT

The Mucosal wave on the left vocal cord were increase from 76 % to 96 %.

GLOTTAL CLOSURE

Remarkable improvement in complete glottal closure were noted post operatively which source and increase of 96% in this parameters .

ADDITIONAL FINDINGS

Post operatively, the prevalence of additional findings was clearly seen, LPR showed almost the decreased incidence.

ACOUSTIC ANALYSSIS

Fundamental Frequency:-

Among 38 Patients the mean fundamental frequency recorded for comfortable voice is 197.1.While the speech frequency is Ranging from 128.3 to 254.2.

F0 is governed by this equation

$$F0 = \frac{1}{2L}\sqrt{\frac{\sigma}{\rho}}$$

F0 = fundamental frequency, 2L = Length of Vocal folds

σ = Longitudinal stress ρ = Tissue density

Fundamental Frequency				
		Mean	S.D	P-Value
LOW/A/ MEAN PIT	PRE	178.68	41.84	0.001
	POST	184.56	43.38	
LOW/E/ MEAN PIT	PRE	179.94	45.70	0.074
	POST	185.23	37.19	
LOW/I/ MEAN PIT	PRE	175.32	41.72	0.051
	POST	179.61	43.56	
COM/A/ MEAN PIT	PRE	195.27	38.06	0.141
	POST	202.52	49.94	
COM/E/ MEAN PIT	PRE	207.21	42.41	0.333
	POST	210.26	43.56	
COM/I/ MEAN PIT	PRE	191.75	35.33	0.0005
	POST	206.71	33.78	
COM/SP/ MEAN PIT	PRE	194.55	40.62	0.378
	POST	197.12	42.05	

Table-6-Fundamental Frequency

Post Operative analysis reveals significant deviation from the pre operative value.

STANDARD DEVIATION OF PITCH

Pre-OP mean value is 28.3 and Post-Op Mean Value is 18.7 for this parameter.

STANDARD DEVIATION OF PITCH				
		Mean	**S.D**	**P-Value**
Std Devi 1	Pre OP	33.00	17.93	0.0005
	Post OP	15.24	11.66	
Std Devi 2	Pre OP	25.89	14.08	0.005
	Post OP	16.40	15.66	
Std Devi 3	Pre OP	31.03	23.00	0.0005
	Post OP	17.32	18.30	
Std Devi 4	Pre OP	26.42	30.92	0.06
	Post OP	16.98	15.28	
Std Devi 5	Pre OP	27.03	23.79	0.0005
	Post OP	13.90	11.66	
Std Devi 6	Pre OP	28.33	18.74	0.725
	Post OP	26.59	17.38	
Std Devi 7	Pre OP	26.50	10.14	0.408
	Post OP	24.35	11.77	

Table 7 - Standard Deviation of Pitch

Post Operative value shows significant improvements.

JITTER

Pre Operative Mean Value of jitter is 1.91 and Post Operative mean is 1.30.

JITTER				
		Mean	**S.D**	**P-Value**
Jitter 1	Pre OP	1.740	0.68	0.0005
	Post OP	1.191	0.57	
Jitter 2	Pre OP	3.060	3.85	0.026
	Post OP	1.515	1.19	
Jitter3	Pre OP	1.783	0.89	0.071
	Post OP	1.526	0.98	
Jitter 4	Pre OP	1.291	0.64	0.009
	Post OP	0.824	0.66	
Jitter 5	Pre OP	1.951	1.39	0.208
	Post OP	1.475	1.64	
Jitter 6	Pre OP	1.847	0.83	0.0005
	Post OP	1.028	0.76	
Jitter 7	Pre OP	1.761	0.42	0.007
	Post OP	1.551	0.20	

Table 8 - Jitter

Post operative analyse of data's reveals a trend toward improvement.

SHIMMER

The mean of this parameter Pre Operatively is 7.9 and Post Operatively is 4.5.

SHIMMER				
		Mean	**S.D**	**P-Value**
Shimmer 1	Pre OP	9.527	4.48	0.002
	Post OP	6.118	3.85	
Shimmer 2	Pre OP	10.184	8.78	0.009
	Post OP	6.413	3.04	
Shimmer 3	Pre OP	7.924	2.26	0.007
	Post OP	6.593	2.38	
Shuimmer 4	Pre OP	7.654	4.65	0.0005
	Post OP	1.492	1.16	
Shimmer 5	Pre OP	6.141	2.91	0.0005
	Post OP	1.947	1.16	
Shimmer 6	Pre OP	5.868	2.66	0.0005
	Post OP	2.737	1.89	
Shimmer 7	Pre OP	8.526	2.87	0.001
	Post OP	6.443	1.75	

Table-9-Shimmer

There is improvement in Shimmer shows When compared to post operatively.

HARMONIC NOISE RATIO (HNR)

Mean of this parameter pre operatively 0.0104 and Post Operatively 0.119.

Harmonic Noise Ratio(HNR)				
		Mean	S.D	P-Value
HNR 1	Pre OP	.1500	.069	0.004
	Post OP	.1104	.045	
HNR 2	Pre OP	.0619	.024	0.01
	Post OP	.0828	.038	
HNR 3	Pre OP	.0848	.037	0.603
	Post OP	.0879	.019	
HNR 4	Pre OP	.1605	.079	0.033
	Post OP	.1942	.084	
HNR 5	Pre OP	.0942	.058	0.0005
	Post OP	.1375	.062	
HNR 6	Pre OP	.0912	.063	0.0005
	Post OP	.1242	.031	
HNR 7	Pre OP	.0907	.036	0.052
	Post OP	.1018	.032	

Table-10-Harmonic Noise Ratio

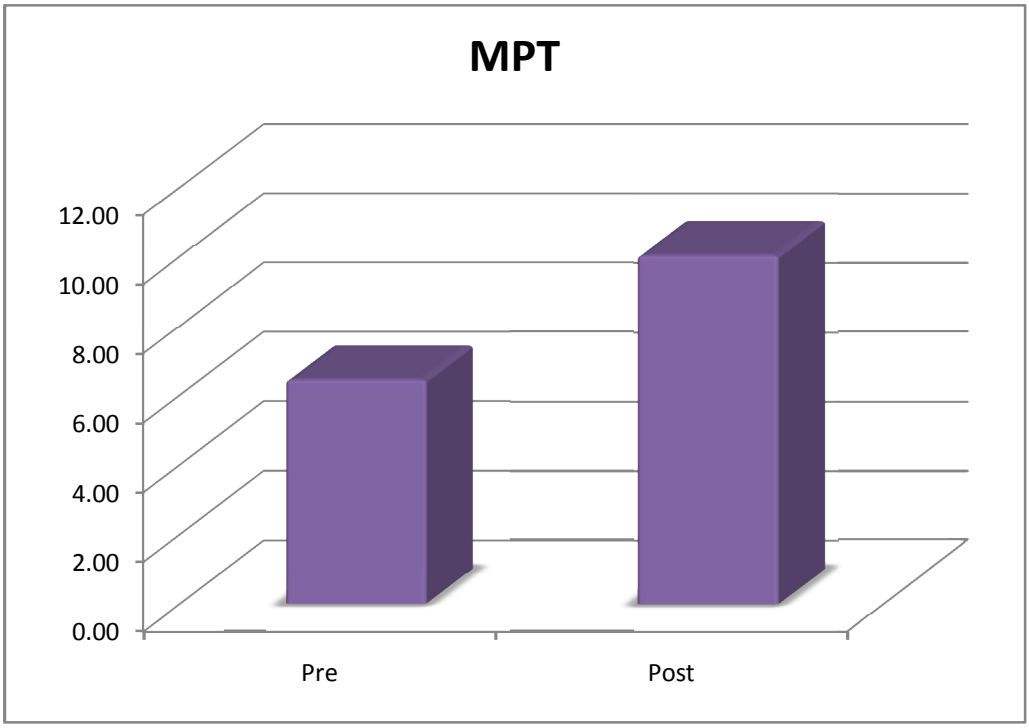
Post Operative data analysis shows improvement in Harmonic Noise Ratio with Significant p Value.

MAXIMUM PHONATION TIME

The Mean Value of this parameter Pre Operatively 6.45 and Post-Operatively is 10.05

Maximum Phonation Time				
		Mean	S.D	P-Value
MPT	Pre OP	6.447	2.617	0.0005
	Post OP	10.053	2.026	

Table-11-Maximum Phonation Time



Postoperatively the maximum phonation time shows increase trend with statistically significant p value (p=0.0005)

VOICE HANDICAP INDEX (VHI)

The Mean of this parameter Preoperatively is 23.7 and post operatively is 6.9.

VOICE HANDICAP INDEX				
		Mean	**S.D**	**P-Value**
VHI 1	Pre OP	22.26	4.14	0.0005
	Post OP	7.39	1.15	
VHI 2	Pre OP	23.55	4.88	0.0005
	Post OP	6.13	1.51	
VHI 3	Pre OP	25.50	4.40	0.0005
	Post OP	7.45	1.62	
VHI 4	Pre OP TOTAL	52.53	16.44	0.0005
	Post OP TOTAL	20.97	3.01	

Table-12-Voice Handicap Index

Analysis was done by using RATHER PAIRED T test with statistically significant p value(p=0.0005) which shows overall improvement in the VHI Scores when compared pre-operatively.

SUB GROUP ANALYSIS

Male and Female

Females preponderance seen more when compared to male (M=16:F=22).Both sex shows better improvement in voice after surgical treatment as shown below.

		FEMALE			MALE		
		Mean	**S.D**	**P-Value**	**Mean**	**S.D**	**P-Value**
VHI 1	Pre	22.09	4.023	0.0005	22.50	4.427	0.0005
	Post	7.32	1.211		7.50	1.095	
VHI 2	Pre	23.50	4.993	0.0005	23.63	4.884	0.0005
	Post	6.23	1.631		6.00	1.366	
VHI 3	Pre	25.41	4.020	0.0005	25.63	5.005	0.0005
	Post	7.55	1.738		7.31	1.493	
TOTAL	Pre	51.59	16.185	0.0005	53.81	17.233	0.0005
	Post	21.09	3.250		20.81	2.738	

Table-13-Sub group analysis Male and Female

SMOKERS Vs NON SMOKERS

In this study there are 10 Smokers out of 38 Patients and all smokers are Males only. Smokers shows higher VHI Value than Non Smokers.

Post Operative Analysis Shows improvement in Emotional Component and Total score of VHI in Smokers.

Non Smokers shows satisfactory improvement in all the components of VHI with statistically significant p value.

		SMOKER			NON SMOKER		
		Mean	S.D	P-Value	Mean	S.D	P-Value
VHI 1	Pre	20.50	3.78	0.0005	22.89	4.15	0.0005
	Post	7.30	1.16		7.43	1.17	
VHI 2	Pre	21.10	3.98	0.0005	24.43	4.93	0.0005
	Post	5.70	1.49		6.29	1.51	
VHI 3	Pre	23.00	4.14	0.0005	26.39	4.20	0.0005
	Post	7.40	1.51		7.46	1.69	
TOTAL	Pre	45.70	8.42	0.0005	54.96	17.98	0.0005
	Post	20.40	3.10		21.18	3.01	

Table-14-Sub group analysis-Smokers and Non Smokers

DISCUSSION

DISCUSSION

Vocal cord benign lesions like vocal nodules, polyps and cysts are significant because they alter the vocal fold vibratory function causing voice disorders. Microlaryngeal surgery applied to for those Lesions not responsive to voice therapy / medical therapy . Goals of treatment are complete excision of lesions and thereby restoring the better vocal cord functional levels. Pre operative and post operative assessment will help to evaluate the quality of the treatment and Documentaion of the lesions by video stroboscopy and by voice analyzer helps the surgeon to fine tune his skills.

In our study three parameters evaluated namely videostroboscopy, voice analysis ,VHI scores in 38 patients with benign lesions before micro laryngeal surgery and 6 weeks(42 Days) after microlaryngeal surgery. There were 16 males (42%) patients and 22 female patients (58%) indicating female predominence[24,25,26,27,28,29,30,31].

Smoking noted in 10 Patients (26%) those all are males which plays important role in producing erythema, oedema and inflammation of the vocal cord framework. Rest of 6 Males and all females are non smokers. Vocal Cyst and Nodule were the most common benign lesion. The vocal fold vibratory function was assessed by the stroboscopic parameters, glottic closure configuration whether complete or incomplete, integrity of mucosal wave (whether normal or abnormal). The vocal fold lesions prevent a

complete glottic closure. The entire patient had an incomplete glottic closure (100%). Excision of the lesion resulted in complete glottic closure in 95% patients. Complete glottic closure results in greater vocal fold contact because of a smooth edge, with generation of a greater subglotic pressure and better amplitude of cord vibration. The resulting equality of vocal fold mass and regular oscillation of each fold produces an improved voice. The mucosal wave was absent on the right in 21 while on the left it was absent in 29.

Post operatively on the right cord it increased to 95 % and on the left it was to 96 %. The absence or dampening of the mucosal waves is due to the extensive involvement of the subepithelium and the superficial layer of lamina propria in vocal polyps and cyst24. After phonosurgery restoration of mucosal vibratory function would result in a good voice25.

Looking at individual pathologies nodule and cysts (n=16) were the majority of lesions. The stroboscopic assessment of closure pattern showed 100 % incomplete closure.Type of closure seen were Hourglass (n=14)(95%) and Posterior Chink(n=2)(5%).

The VHI datas represent the patient's perception of the problem in daily life in relation to the patient's emotional, functional and physical activities. VHI also can be used to evaluating the effectiveness of specific voice treatment techniques. In this study the mean pre-operative score is 52.5 which is decreased to 21.09 post operatively with statistically

significant p value. Behrman et al[31] retrospective study Suggested that the amount of voice demand in relation to patient's life style and working status influence VHI score. Routine voice users had significantly lower VHI scores than those with the high vocal demands. Overall the VHI scores were low in benign mucosal lesion tend to result in milder voice disorder compared to neurological disorder.[33]

The acoustic analysis was done using PHONOLAB programme created Analysis of a sustained tone reveals fundamental frequency (Fo), the average pitch measured in hertz (Hz). The normal fundamental frequency for males is 100-150 Hz and that for female is 190- 250 Hz.

Low fundamental frequency noted in Voices associated with chronic vocal abuse, misuse or vocal mass lesion.

In this study the pre operative fundamental frequency for male was 153.6 Hz and females was 214.7 Hz. In the post operative status fundamental frequency for males was 163.5 Hz and females was 218.2 Hz, which shows significant improvement postoperatively. The Periodicity of the Vocal Cord Vibration which correlate with the Frequency perturbation or jittering the pre operative status(1.91) was greater than post operatively (1.30) . Shimmer Pre operatively (7.9) and post operatively (4.5) which shows reduction implies that it was improved.

CONCLUSION

CONCLUSION

Vocal cords are very delicated and intricate structure that help a human being to Breath, Speak as well as to sings. It is a micro structure and their functions are very accurate, even a small change in it by a lesion can produce enormous change in its function (Voice and Singing).

Hence a PHONOSURGEON to give a Near-perfect voice for professional and non professional voice users with lesions in vocal cord must use Video Stroboscopy with voice analyser.

ADVANTAGES OF VIDEO STROBOSCOPE VS CONVENTIONAL VIDEO ENDOSCOPE

1. It gives predictive value to surgical treatment of vocal fold lesion like Cysts, Nodule, Polyp.

2. Pre Operative precise assessment of the alteration in the structure and function of vocal cord lesions.

3. Planning of Surgical techniques according to the lesions.

4. Post operative review and assessment of return back of structure and functions.

5. Documentaion of the lesions pre and post operatively by video stroboscopy helps the surgeon to fine tune his skills.

6. Documentation helps the phonosurgeon in legal aspects especially while operating professional voice users.

With the above mentioned advantage a phonosurgeon can use video stroboscopy with voice analyzer and voice handicap index as a tool to give best anatomical and functional results.

In conclusion pre and post operative assessment of patients with benign vocal cord mass lesions by stroboscopy, acoustic analysis and Voice Handicap Index is a useful way to assess the degree of improvement following surgery.

Both subjective and objective parameters are assessed. Both patients and surgeons provided with a definitive evaluation with respect to the benefit following surgery and speech therapy.

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PROFORMA

PROFORMA

Name : Age :

Sex :

Occupation :

Address :

Hospital number :

Consent form :

Complaint Duration :

Voice abuse :

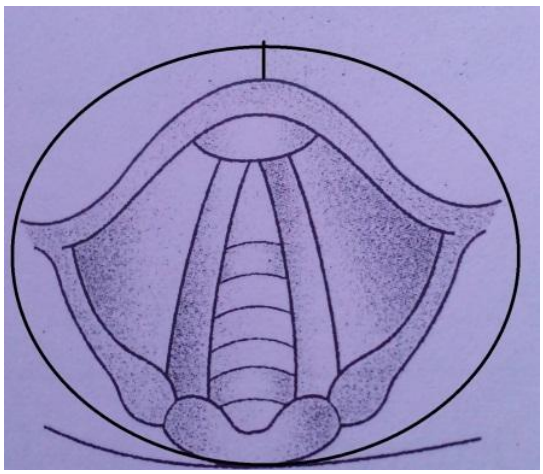
LPR :

Smoking :

Diagnosis :

Surgery date : Follow up date:

VLS scopy report :



STROBOSCOPIC PARAMETERS:

Symmetry:

Mucosal wave Right:

Left:

Glottic closure:

ACOUSTIC ANALYSIS:

1. Fundamental frequency

2. Standard deviation of fundamental frequency

3. Jitter

4. Shimmer 5. Harmonic to noise ratio

	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5	Sound 6	Speech
1							
2							
3							
4							
5							

VOICE HANDICAP INDEX:

Functional :

Physical :

Emotional :

Total :

Date:

POST OPERATIVE

Stroboscopy :

Symmetry :

Mucosal wave Right :

Left

Glottic closure :

ACOUSTIC ANALYSIS :

1. Fundamental frequency
2. Standard deviation of fundamental frequency
3. Jitter
4. Shimmer
5. Harmonic to noise ratio

	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5	Sound 6	Speech
1							
2							
3							
4							
5							

VOICE HANDICAP INDEX:

Functional :

Physical :

Emotional :

Total :

Date:

VOICE HANDICAP INDEX

Instructions: These are statements that many people have used to describe their voices and the effects of their voices on their lives. Circle the response that indicates how frequently you have the same experience.

0 _ Never 1 _ Almost Never 2 _ Sometimes 3 _
Almost Always 4 _ Always

PART I: FUNCTIONAL

F1 My voice makes it difficult for people to hear me. 0 1 2 3 4

F2 People have difficulty understanding me in a noisy room. 0 1 2 3 4

F3 My family has difficulty hearing me when I call them throughout the house. 0 12 3 4

F4 I use the phone less often than I would like to. 0 1 2 3 4

F5 I tend to avoid groups of people because of my voice. 0 1 2 3 4

F6 I speak with friends, neighbors, or relatives less often because of my voice. 0
1 2 3 4

F7 People ask me to repeat myself when speaking face-to-face. 0 1 2 3 4

F8 My voice difficulties restrict personal and social life. 0 1 2 3 4

F9 I feel left out of conversations because of my voice. 0 1 2 3 4

F10 My voice problem causes me to lose income. 0 1 2 3 4

PART II: PHYSICAL

P1 I run out of air when I talk. 0 1 2 3 4

P2 The sound of my voice varies throughout the day. 0 1 2 3 4

P3 People ask, “What’s wrong with your voice?” 0 1 2 3 4

P4 My voice sounds creaky and dry. 0 1 2 3 4

P5 I feel as though I have to strain to produce voice. 0 1 2 3 4

P6 The clarity of my voice is unpredictable. 0 1 2 3 4

P7 I try to change my voice to sound different. 0 1 2 3 4

P8 I use a great deal of effort to speak. 0 1 2 3 4

P9 My voice is worse in the evening. 0 1 2 3 4

P10 My voice "gives out" on me in the middle of speaking. 0 1 2 3 4

PART III: EMOTIONAL

E1 I am tense when talking to others because of my voice. 0 1 2 3 4

E2 People seem irritated with my voice. 0 1 2 3 4

E3 I find other people don't understand my voice problem. 0 1 2 3 4

E4 My voice problem upsets me. 0 1 2 3 4

E5 I am less outgoing because of my voice problem. 0 1 2 3 4

E6 My voice makes me feel handicapped. 0 1 2 3 4

E7 I feel annoyed when people ask me to repeat. 0 1 2 3 4

E8 I feel embarrassed when people ask me to repeat. 0 1 2 3 4

E9 My voice makes me feel incompetent. 0 1 2 3 4

E10 I am ashamed of my voice problem. 0 1 2 3 4

FUNCTIONAL	PHYSICAL	EMOTIONAL	TOTAL

ETHICAL COMMITTEE

APPROVAL LETTER

ETHICAL COMMITTEE APPROVAL LETTER

INSTITUTIONAL ETHICAL COMMITTEE,
STANLEY MEDICAL COLLEGE, CHENNAI-1

Title of the Work : A Comparative study of benign vocal cord mass lesions using videostroboscopy voice analysis and voice handicap index before and after microlaryngoal surgery .

Principal Investigator : Dr. V Ravi Kumar,

Designation : M.S ,(E N T)

Department : Department of E N T
Government Stanley Medical College,
Chennai-01

The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 26.11.2014 at the Council Hall, Stanley Medical College, Chennai-1 at 2PM

The members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

The Principal investigator and their team are directed to adhere to the guidelines given below:

1. You should inform the IEC in case of changes in study procedure, site investigator investigation or guide or any other changes.
2. You should not deviate from the area of the work for which you applied for ethical clearance.
3. You should inform the IEC immediately, in case of any adverse events or serious adverse reaction.
4. You should abide to the rules and regulation of the institution(s).
5. You should complete the work within the specified period and if any extension of time is required, you should apply for permission again and do the work.
6. You should submit the summary of the work to the ethical committee on completion of the work.

K Vasantha

MEMBER SECRETARY,
IEC, SMC, CHENNAI

PATIENT INFORMATION SHEET

PATIENT INFORMATION SHEET

தகவல் படிவம்

தங்களுக்கு செய்த பரிசோதனைகள் மூலம் தங்கள் தொண்டையில் சதை வளர்ந்திருப்பது தெரியவந்துள்ளது. இதன் விளைவாகதங்களின் குரல் மாற்றமடையவாய்ப்புஉள்ளது.

இந்தநோயை கண்டறிய பலவகை பரிசோதனை முறைகள் உள்ளன. அதில் VIDEOSTROBOSCOPY, VOICEANALYSIS, VOICE HANDICAPE INDEX என்ற பரிசோதனை முறைகள் பயன்படுத்தப்பட உள்ளன. இந்த பரிசோதனை முறைகள் மூலம் தொண்டையில் வளர்ந்துள்ள சதை அறுவை சிகிச்சைக்கு முன் மற்றும் அறுவை சிகிச்சைக்குப் பின் விளைவுகளை ஒப்பிட்டு ஆய்வு மேற்கொள்ளபட உள்ளது. இது குறித்த விவரங்களைஆய்வில் பயன்படுத்த விரும்புகிறோம்.

தாங்கள் விரும்பினால் மருத்துவஆய்வில் இருந்து எப்பொழுது வேண்டுமானாலும் விலகிக் கொள்ளலாம். எந்த சட்ட சிக்கலுக்கும் எப்பொழுது வேண்டுமானாலும் தாங்கள் ஆய்விலிருந்துவிலகிக் கொள்ளலாம்.

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களும், பரிசோதனை முடிவுகளும் தங்களின் ஒப்புதலின் மூலம் மட்டும் ஆய்வில் பயன்படுத்தப்படும்.

ஆய்வாளரின் கையொப்பம் :

ஆய்வாளரின் பெயர் :

இடம் :
நாள் :

INFORMED CONCENT

FORM

INFORMED CONCENT FORM

சுய ஒப்புதல் படிவம்

ஆராய்ச்சிநிலையம் : காது, மூக்கு,தொண்டைபிரிவு

அரசு ஸ்டான்லிமருத்துவக் கல்லூரிமருத்துவமனை,சென்னை- 600 001.

பங்குபெறுபவரின் பெயர் :

பங்குபெறுபவரின் எண் :

மருத்துவபரிசோதனையின் விவரங்கள் எனக்குவிளக்கப்பட்டது. எனது தொண்டையில் சதை வளர்ந்துள்ளது என்பது தெரியப்படுத்தப்பட்டது. எனது தொண்டை நோய் பற்றிய சந்தேகங்கள் மற்றும் சோதனை முறைகளைப் பற்றி கேட்கவும் அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டது. இந்த நோயை கண்டறிய பலவகை சோதனை முறைகள் உள்ளன என்பதும் எனக்கு VIDEOSTROBOSCOPY, VOICEANALYSIS, VOICE HANDICAPE INDEX என்ற பரிசோதனை முறைகள் பயன்படுத்தப்பட உள்ளது என்பதும் இந்தமுறையில் எனது தொண்டையில் வளர்ந்துள்ள சதை அறுவை சிகிச்சை மூலம் அகற்றுவதற்கு முன் மற்றும் அறுவை சிகிச்சைக்குப் பின் பயன்படுத்துவது குறித்து சோதனை முறையில் விளைவுகளை ஆய்வில் பயன்படுத்தவும் தன்னிச்சையாக சம்மதிக்கிறேன். எக்காரணத்தினாலும் எந்தகட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் இந்த ஆய்வில் இருந்து விலகிக் கொள்ளலாம் என்று அறிந்து கொண்டேன்.

இந்த பரிசோதனைகள் மூலம் கிடைக்கும் தகவல்களையும், பரிசோதனை முடிவுகளையும், மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்திக் கொள்ளவும் அதை பிரசுரிக்கவும், தேவைப்பட்டால் என்னையும் எனக்கு நடக்கும் அறுவை சிகிச்சையும் புகைப்படம் எடுக்கவும் நான் முழுமனதுடன் சம்மதிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம் : **இடம் :**
நாள் :

கட்டைவிரல் ஒப்பம் :

பங்கேற்பவரின் பெயர்மற்றும் விலாசம் :

ஆய்வாளரின் கையொப்பம் : **இடம் :**
நாள் :

ஆய்வாளரின் பெயர் :

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Submitted to the
THE TAMILNADU DR. M.G.R.MEDICAL UNIVERSITY
In Partial fulfilment of the regulations
For the award of the degree of
M.S.BRANCH IV
(OTORHINOLARYNGOLOGY)
GOVERNMENT STANLEY MEDICAL
COLLEGE & HOSPITAL

LEGEND FOR MASTER CHART

Periodicity :- Present-1 Absent-2

Symmetry :- Presnt-1 Absent-2

Glottic Closure :- Complete-1 Incomplete-2

Side Of Lesion :- Right-1 Left-2 Both-3 Not Applicable-4

Position of Lesion-Anterior 3rd-1 Middle 3rd-2 Posterior 3rd -3 Anterior and Middle Junction-4 Superior Surfece-5 Not Applicable-6

Lesions :- Polyp-1 Cyst-2 Nodule-3 Not applicable-4

Present-1 Absent-2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	CASE NO	OP NO	SEX	OCCUPATION	AGE	location	DURATION	VOICE	SMOKI	LPR	PERIOD	YMMETR	MUCOS	MUCOSAL
1	1	135623	F	TEACHER	32	CHENNAI	2M	1	2	1	1	2	1	2
2	2	137261	M	VENDOR	58	CHENNAI	6M	1	1	1	1	2	1	2
3	3	157669	F	HW	40	CHENNAI	3YRS	1	2	1	1	2	2	2
4	4	187987	M	HOUSEKEEPING	34	CHENNAI	4YRS	1	2	1	1	2	1	2
5	5	188465	F	HW	40	CHENNAI	3M	1	2	2	1	2	2	2
6	6	242687	F	HW	37	CHENNAI	2M	1	2	1	1	2	1	2
7	7	254294	M	TELE OP	62	CHENNAI	1YR	1	1	1	1	2	1	2
8	8	276298	F	FISHER	42	CHENNAI	4M	1	2	1	1	2	1	2
9	9	419739	F	KABADI	23	CHENNAI	3YRS	1	2	1	1	2	2	2
10	**10**	**7736**	**F**	HW	32	CHENNAI	3M	1	2	1	1	2	1	2
11	11	140201	M	TEACHER	32	CHENNAI	6M	1	1	1	1	2	1	2
12	12	387085	F	HW	57	CHENNAI	1YR	1	2	1	1	2	2	2
13	13	319056	F	STUDENT	13	CHENNAI	6M	1	2	2	1	2	2	2
14	14	250218	F	HW	45	CHENNAI	4M	1	2	1	1	2	2	2
15	15	32509	M	VENDOR	39	CHENNAI	3M	1	2	1	1	2	2	1
16	16	213158	F	STUDENT	15	CHENNAI	6M	1	2	1	1	2	2	2
17	17	8680	M	VENDOR	51	CHENNAI	3M	1	2	1	1	2	1	2
18	18	322793	F	STUDENT	14	CHENNAI	1YR	1	2	1	1	2	1	2
19	19	354415	F	HW	34	CHENNAI	2YR	1	2	1	1	2	2	2
20	20	20533	F	HW	32	CHENNAI	1YR	1	2	1	1	2	2	2
21	21	44237	F	HW	43	CHENNAI	4YRS	1	2	1	1	2	2	1
22	22	12389	M	VENDOR	47	CHENNAI	1YR	1	1	2	1	2	2	1
23	23	420899	F	STUDENT	23	CHENNAI	6M	1	2	1	1	2	2	2
24	24	8105	F	STUDENT	24	CHENNAI	5M	1	2	1	1	2	2	2
25	25	13366	M	STUDENT	18	CHENNAI	1YR	1	1	1	1	2	2	1
26	26	1680	M	VENDOR	51	CHENNAI	3M	1	2	1	1	2	1	2
27	27	22793	F	STUDENT	24	CHENNAI	1YR	1	2	1	1	2	1	2
28	28	140334	M	STUDENT	21	CHENNAI	6M	1	1	2	1	2	1	2
29	29	2389	M	VENDOR	57	CHENNAI	1YR	1	1	1	1	2	2	1
30	30	40334	M	STUDENT	23	CHENNAI	1YR	1	1	1	1	2	1	2
31	31	156176	M	CASHIER	34	CHENNAI	1YR	1	2	1	1	2	1	2
32	32	14237	F	HW	43	CHENNAI	4YRS	1	2	2	1	2	2	1
33	33	40201	M	TEACHER	42	CHENNAI	6M	1	1	1	1	2	1	2
34	34	87085	F	PREACHER	47	CHENNAI	7M	1	2	1	1	2	2	2
35	35	385139	M	STUDENT	24	CHENNAI	6M	1	2	1	1	2	2	1
36	36	14347	F	HW	43	CHENNAI	1YR	1	2	1	1	2	2	1
37	37	343366	M	VENDOR	56	CHENNAI	8M	1	1	1	1	2	1	2
38	38	85139	F	HW	34	CHENNAI	6M	1	2	1	1	2	2	1

	CU	CV	CW	CX	CY	CZ	DA	DB	DC	DD
Sno	HNR 4 PO	HNR 5 PO	HNR 6 PO	HNR 7 PO	VHI 1 PO	VHI 2 PO	VHI 3 PO	VHI TOTAL	Pre OP	PostopMP
1	0.0817	0.0503	0.103	0.0816	8	7	10	25	4.98	8.91
2	0.26	0.0772	0.0946	0.1328	9	6	5	20	7.73	10.46
3	0.0837	0.2131	0.0942	0.0826	5	4	8	17	1.76	6.64
4	0.3001	0.2106	0.1668	0.0726	9	7	8	24	11.14	14.98
5	0.1061	0.0751	0.0853	0.0721	6	5	7	18	4.65	8.25
6	0.2883	0.1722	0.1103	0.1002	7	8	9	24	6.35	9.38
7	0.1739	0.1382	0.1317	0.1005	6	8	9	23	10.18	13.15
8	0.183	0.1595	0.1643	0.1614	8	9	5	22	6.82	8.12
9	0.2075	0.2135	0.1654	0.1131	7	6	9	22	3.31	9.83
10	0.2121	0.1344	0.1253	0.0905	9	7	9	25	5.83	10.87
11	0.26	0.0872	0.0956	0.1558	6	4	5	15	7.92	10.57
12	0.0817	0.0503	0.103	0.0816	7	9	8	24	3.77	7.76
13	0.0837	0.2131	0.0942	0.0826	8	7	9	24	5.37	8.38
14	0.1061	0.0751	0.0853	0.0721	7	6	8	21	4.31	10.67
15	0.3001	0.2106	0.1668	0.0726	7	6	8	21	5.83	10.87
16	0.2883	0.1722	0.1103	0.1002	5	8	9	22	6.04	8.45
17	0.3001	0.2106	0.1668	0.0726	9	7	8	24	3.65	9.78
18	0.183	0.1595	0.1643	0.1614	8	4	7	19	5.34	10.76
19	0.2075	0.2135	0.1654	0.1131	6	5	3	14	6.78	10.09
20	0.2121	0.1344	0.1253	0.0905	7	5	8	20	7.98	9.98
21	0.0817	0.0503	0.103	0.0816	6	5	8	19	10.78	14.15
22	0.1739	0.1382	0.1317	0.1005	6	3	7	16	7.87	9.15
23	0.0837	0.2131	0.0942	0.0826	7	5	6	18	3.34	10.86
24	0.1061	0.0751	0.0853	0.0721	9	7	8	24	10.09	13.15
25	0.26	0.0872	0.0956	0.1558	8	6	7	21	6.82	8.12
26	0.3001	0.2106	0.1668	0.0726	8	5	7	20	3.31	9.83
27	0.183	0.1595	0.1643	0.1614	8	7	6	21	4.98	8.91
28	0.26	0.0872	0.0956	0.1558	8	5	7	20	7.73	10.46
29	0.1739	0.1382	0.1317	0.1005	6	5	8	19	1.76	6.64
30	0.26	0.0872	0.0956	0.1558	8	7	9	24	11.14	14.98
31	0.1739	0.1382	0.1317	0.1005	7	6	8	21	5.67	8.25
32	0.0817	0.0503	0.103	0.0816	7	4	6	17	6.35	9.38
33	0.26	0.0872	0.0956	0.1558	8	7	9	24	10.18	13.15
34	0.0817	0.0503	0.103	0.0816	8	7	9	24	6.82	9.12
35	0.3001	0.2106	0.1668	0.0726	7	8	4	19	3.31	9.83
36	0.0817	0.0503	0.103	0.0816	9	4	5	18	7.73	10.46
37	0.3001	0.2106	0.1668	0.0726	8	6	8	22	6.35	9.38
38	0.3001	0.2106	0.1668	0.0726	9	8	9	26	10.98	10.09

	CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	CT
	JITTE	JITTE	JITTER	JITTE	SHIMME	SHIMME	SHIM	SHIMM	SHIMME	SHIMME	SHIM	HNR 1 PO	HNR2 PO	HNR 3 PO
1	1.41	5.04	2.35	1.65	2.84	11.54	8.16	2.42	3.27	3.72	4.79	0.0664	0.0682	0.0825
2	0.28	1.5	0.67	1.42	6.06	5.64	5.59	0.22	0.7	0.41	3.99	0.0645	0.0387	0.0671
3	0.38	0.38	0.41	1.58	2.45	0.73	4.89	0.32	0.49	0.33	6.06	0.0675	0.0511	0.0624
4	0.45	0.25	0.49	1.37	10.21	6.14	6.59	0.82	0.93	3.99	7.88	0.1202	0.0934	0.1015
5	1.18	1.17	1.79	1.32	8.19	3.66	6.33	1.1	3.66	6.73	7.54	0.0744	0.0751	0.07
6	0.27	0.52	0.34	1.86	3.17	5.56	5.14	1.23	3.21	2.73	9.65	0.0938	0.0818	0.1056
7	0.62	0.34	0.32	1.49	13.11	9.67	12.03	3.98	2.01	1.85	7.48	0.1664	0.0799	0.0887
8	2.55	1.63	0.99	2.01	1.54	5.31	6.15	2.23	1.62	1.4	5.01	0.1814	0.1908	0.1111
9	1.03	0.81	2.06	1.81	3.11	4.81	3.42	1.08	3.09	4.67	7.47	0.1761	0.1143	0.1352
10	0.31	0.75	0.93	1.45	3.03	4.56	2.27	1.82	2.85	1.86	8.51	0.1718	0.0921	0.0577
11	0.28	1.5	0.67	1.42	6.06	5.64	5.59	0.22	0.7	0.41	3.99	0.0745	0.0397	0.0771
12	1.41	5.04	2.35	1.65	2.84	11.54	8.16	2.42	3.27	3.72	4.79	0.0664	0.0682	0.0825
13	0.38	0.38	0.41	1.58	2.45	0.73	4.89	0.32	0.49	0.33	6.06	0.0675	0.0511	0.0624
14	1.18	1.17	1.79	1.32	8.19	3.66	6.33	1.1	3.66	6.73	7.54	0.0744	0.0751	0.07
15	0.45	0.25	0.49	1.37	10.21	6.14	6.59	0.82	0.93	3.99	7.88	0.1202	0.0934	0.1015
16	0.27	0.52	0.34	1.86	3.17	5.56	5.14	1.23	3.21	2.73	9.65	0.0938	0.0818	0.1056
17	0.45	0.25	0.49	1.37	10.21	6.14	6.59	0.82	0.93	3.99	7.88	0.1202	0.0934	0.1015
18	2.55	1.63	0.99	2.01	1.54	5.31	6.15	2.23	1.62	1.4	5.01	0.1814	0.1908	0.1111
19	1.03	0.81	2.06	1.81	3.11	4.81	3.42	1.08	3.09	4.67	7.47	0.1761	0.1143	0.1352
20	0.31	0.75	0.93	1.45	3.03	4.56	2.27	1.82	2.85	1.86	8.51	0.1718	0.0921	0.0577
21	1.41	5.04	2.35	1.65	2.84	11.54	8.16	2.42	3.27	3.72	4.79	0.0664	0.0682	0.0825
22	0.62	0.34	0.32	1.49	13.11	9.67	12.03	3.98	2.01	1.85	7.48	0.1664	0.0799	0.0887
23	0.38	0.38	0.41	1.58	2.45	0.73	4.89	0.32	0.49	0.33	6.06	0.0675	0.0511	0.0624
24	1.18	1.17	1.79	1.32	8.19	3.66	6.33	1.1	3.66	6.73	7.54	0.0744	0.0751	0.07
25	0.28	1.5	0.67	1.42	6.06	5.64	5.59	0.22	0.7	0.41	3.99	0.0745	0.0397	0.0771
26	0.45	0.25	0.49	1.37	10.21	6.14	6.59	0.82	0.93	3.99	7.88	0.1202	0.0934	0.1015
27	2.55	1.63	0.99	2.01	1.54	5.31	6.15	2.23	1.62	1.4	5.01	0.1814	0.1908	0.1111
28	0.28	1.5	0.67	1.42	6.06	5.64	5.59	0.22	0.7	0.41	3.99	0.0745	0.0397	0.0771
29	0.62	0.34	0.32	1.49	13.11	9.67	12.03	3.98	2.01	1.85	7.48	0.1664	0.0799	0.0887
30	0.28	1.5	0.67	1.42	6.06	5.64	5.59	0.22	0.7	0.41	3.99	0.0745	0.0397	0.0771
31	0.62	0.34	0.32	1.49	13.11	9.67	12.03	3.98	2.01	1.85	7.48	0.1664	0.0799	0.0887
32	1.41	5.04	2.35	1.65	2.84	11.54	8.16	2.42	3.27	3.72	4.79	0.0664	0.0682	0.0825
33	0.28	1.5	0.67	1.42	6.06	5.64	5.59	0.22	0.7	0.41	3.99	0.0745	0.0397	0.0771
34	1.41	5.04	2.35	1.65	2.84	11.54	8.16	2.42	3.27	3.72	4.79	0.0664	0.0682	0.0825
35	0.45	0.25	0.49	1.37	10.21	6.14	6.59	0.82	0.93	3.99	7.88	0.1202	0.0934	0.1015
36	1.41	5.04	2.35	1.65	2.84	11.54	8.16	2.42	3.27	3.72	4.79	0.0664	0.0682	0.0825
37	0.45	0.25	0.49	1.37	10.21	6.14	6.59	0.82	0.93	3.99	7.88	0.1202	0.0934	0.1015
38	0.45	0.25	0.49	1.37	10.21	6.14	6.59	0.82	0.93	3.99	7.88	0.1202	0.0934	0.1015

	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF
	(COMA	(COME)	(COMI)	(COM	STD	STD	STD	STD	STD	STD	STD	JITTER	JITTER	JITTER
1	244.62	244.96	223.71	240.47	32.01	44.4	50.54	29.78	33.89	34.75	44.8	2.25	4.03	3.05
2	246.78	239.98	231.72	222.65	5.48	14	2.85	4.79	5.05	10.9	26.38	0.76	1.08	0.68
3	241.66	240.99	246.62	254.27	9.58	2.62	18.7	11.32	21.44	18.06	26.47	0.72	0.72	2.08
4	129.95	144.27	153.88	145.22	5.46	2.91	2.42	8.61	3.13	53.44	9.44	1.17	0.57	0.65
5	224.41	225.34	212.34	198.06	9.77	12.77	18.21	11.65	12.77	27.69	9.96	1.14	1.17	1.46
6	196.81	245.03	213.84	229.46	5.53	9.15	11.53	4.53	3.29	5.11	29.08	0.43	0.81	0.67
7	133.75	145.21	166.44	128.3	23.53	4.78	5.01	30.62	8.19	3.79	21.02	1.66	0.91	1.5
8	187.88	217.34	223.28	190.89	16.9	29.11	22.17	54.74	29.67	31.52	32.49	0.81	1.6	1.74
9	210.99	219.11	197.26	208.61	41.51	38.15	47.3	3.06	13.17	41.79	24.86	1.23	2.57	3.46
10	262.68	255.11	255.36	188.11	9.53	2.68	3	3.34	7.75	10.85	16.76	0.52	1.02	0.48
11	246.78	239.98	231.72	222.65	5.48	14	2.85	4.79	5.05	10.9	26.38	0.76	1.08	0.68
12	244.62	244.96	223.71	240.47	32.01	44.4	50.54	29.78	33.89	34.75	44.8	2.25	4.03	3.05
13	241.66	240.99	246.62	254.27	9.58	2.62	18.7	11.32	21.44	18.06	26.47	0.72	0.72	2.08
14	224.41	225.34	212.34	198.06	9.77	12.77	18.21	11.65	12.77	27.69	9.96	1.14	1.17	1.46
15	129.95	144.27	153.88	145.22	5.46	2.91	2.42	8.61	3.13	53.44	9.44	1.17	0.57	0.65
16	196.81	245.03	213.84	229.46	5.53	9.15	11.53	4.53	3.29	5.11	29.08	0.43	0.81	0.67
17	129.95	144.27	153.88	145.22	5.46	2.91	2.42	8.61	3.13	53.44	9.44	1.17	0.57	0.65
18	187.88	217.34	223.28	190.89	16.9	29.11	22.17	54.74	29.67	31.52	32.49	0.81	1.6	1.74
19	210.99	219.11	197.26	208.61	41.51	38.15	47.3	3.06	13.17	41.79	24.86	1.23	2.57	3.46
20	262.68	255.11	255.36	188.11	9.53	2.68	3.12	3.34	7.75	10.85	16.76	0.52	1.02	0.48
21	244.62	244.96	223.71	240.47	32.01	44.4	50.54	29.78	33.89	34.75	44.8	2.25	4.03	3.05
22	133.75	145.21	166.44	128.3	23.53	4.78	5.01	30.62	8.19	3.79	21.02	1.66	0.91	1.5
23	241.66	240.99	246.62	254.27	9.58	2.62	18.7	11.32	21.44	18.06	26.47	0.72	0.72	2.08
24	224.41	225.34	212.34	198.06	9.77	12.77	18.21	11.65	12.77	27.69	9.96	1.14	1.17	1.46
25	246.78	239.98	231.72	222.65	5.48	14	2.85	4.79	5.05	10.9	26.38	0.76	1.08	0.68
26	129.95	144.27	153.88	145.22	5.46	2.91	2.42	8.61	3.13	53.44	9.44	1.17	0.57	0.65
27	187.88	217.34	223.28	190.89	16.9	29.11	22.17	54.74	29.67	31.52	32.49	0.81	1.6	1.74
28	246.78	239.98	231.72	222.65	5.48	14	2.85	4.79	5.05	10.9	26.38	0.76	1.08	0.68
29	133.75	145.21	166.44	128.3	23.53	4.78	5.01	30.62	8.19	3.79	21.02	1.66	0.91	1.5
30	246.78	239.98	231.72	222.65	5.48	14	2.85	4.79	5.05	10.9	26.38	0.76	1.08	0.68
31	133.75	145.21	166.44	128.3	23.53	4.78	5.01	30.62	8.19	3.79	21.02	1.66	0.91	1.5
32	244.62	244.96	223.71	240.47	32.01	44.4	50.54	29.78	33.89	34.75	44.8	2.25	4.03	3.05
33	246.78	239.98	231.72	222.65	5.48	14	2.85	4.79	5.05	10.9	26.38	0.76	1.08	0.68
34	244.62	244.96	223.71	240.47	32.01	44.4	50.54	29.78	33.89	34.75	44.8	2.25	4.03	3.05
35	129.95	144.27	153.88	145.22	5.46	2.91	2.42	8.61	3.13	53.44	9.44	1.17	0.57	0.65
36	244.62	244.96	223.71	240.47	32.01	44.4	50.54	29.78	33.89	34.75	44.8	2.25	4.03	3.05
37	129.95	144.27	153.88	145.22	5.46	2.91	2.42	8.61	3.13	53.44	9.44	1.17	0.57	0.65
38	129.95	144.27	153.88	145.22	5.46	2.91	2.42	8.61	3.13	53.44	9.44	1.17	0.57	0.65

10	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR
	VHI 3	VHI	PERIODI	SYMME	MUCOSAL	MUCOSAL	GLOTTAL	SIDE	POSITIO	ADD	LESIO	(LOWA)	MEAN	(LOWI)
1	38	38	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	222.05	218.2	214.59
2	21	21	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	164.8	167.01	162.86
3	24	24	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	254.45	237.88	234.35
4	28	28	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	119.75	135.46	113.3
5	23	23	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	216.5	206.41	205.13
6	29	29	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	212.2	188.66	142.45
7	29	29	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	132.41	142.65	148.52
8	22	22	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	193.05	189.22	218.6
9	25	25	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	194.97	212.81	210.64
10	25	25	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	233.96	247.63	241.49
11	22	22	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	164.8	167.01	162.86
12	25	25	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	222.05	218.2	214.59
13	27	27	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	254.45	237.88	234.35
14	25	25	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	216.5	206.41	205.13
15	33	33	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	119.75	135.46	113.3
16	28	28	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	212.2	188.66	142.45
17	28	28	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	129.75	137.46	115.3
18	22	22	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	193.05	189.22	218.6
19	25	25	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	194.97	212.81	210.64
20	29	29	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	233.96	247.63	241.49
21	23	23	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	222.05	218.2	214.59
22	24	24	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	132.41	142.65	148.52
23	22	22	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	254.45	237.88	234.35
24	25	25	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	216.5	206.41	205.13
25	20	20	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	164.8	167.01	162.86
26	28	28	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	129.75	137.46	115.3
27	22	22	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	193.05	189.22	218.6
28	28	28	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	164.8	167.01	162.86
29	17	17	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	132.41	142.65	148.52
30	28	28	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	164.8	167.01	162.86
31	29	29	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	132.41	142.65	148.52
32	18	18	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	222.05	218.2	214.59
33	22	22	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	164.8	167.01	162.86
34	28	28	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	222.05	218.2	214.59
35	34	34	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	129.75	137.46	115.3
36	24	24	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	222.05	218.2	214.59
37	19	19	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	129.75	137.46	115.3
38	30	30	0 1	0 1	0 1	0 1	0 1	0 4	0 6	0 1	0 4	129.75	137.46	115.3

	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD
	SHIMMER 3	SHIMMER4	SHIMMER 5	SHIMMER 6	SHIMMER 7	HNR1	HNR2	HNR 3	HNR 4	HNR 5	HNR 6	HNR 7	VHI 1(F)	VHI 2
1	8.16	11.32	4.73	3.74	9.06	0.11	0.048	0.062	0.1281	0.0531	0.013	0.0862	30	37
2	6.93	8.98	7.21	6.92	11.3	0.184	0.0527	0.0489	0.2193	0.0771	0.0585	0.1002	16	18
3	12.65	14.31	3.39	3.6	4.34	0.0669	0.1275	0.1382	0.0444	0.1149	0.0891	0.0637	22	27
4	6.84	2.72	5.12	5.09	9.35	0.1707	0.08	0.1202	0.1136	0.1018	0.1165	0.0653	21	27
5	6.93	8.6	14.4	9.76	7.48	0.0396	0.0546	0.041	0.1131	0.0492	0.0507	0.0387	22	25
6	11.94	9.29	7.58	9.35	9.79	0.1226	0.0678	0.1162	0.1442	0.0557	0.0924	0.0939	25	26
7	9.03	13.22	7.48	9.93	12.65	0.1758	0.0336	0.1304	0.2231	0.0693	0.1045	0.1167	26	28
8	8.94	1.07	4.53	1.11	4.53	0.1804	0.0564	0.0586	0.1887	0.2663	0.2599	0.1327	18	17
9	2.65	1.16	2.35	6.29	5.41	0.0847	0.0466	0.0853	0.0709	0.0547	0.0637	0.0448	24	21
10	6.01	2.14	4.06	4.49	3.17	0.1306	0.0514	0.0384	0.1786	0.1491	0.1474	0.1856	19	23
11	6.83	8.98	7.41	6.92	11.3	0.284	0.0537	0.0489	0.3193	0.0771	0.0582	0.1102	18	20
12	8.16	11.32	4.73	3.74	9.06	0.11	0.048	0.062	0.1281	0.0531	0.013	0.0862	21	23
13	12.65	14.31	3.39	3.6	4.34	0.0669	0.1275	0.1382	0.0444	0.1149	0.0891	0.0637	20	24
14	6.93	8.6	14.4	9.76	7.48	0.0396	0.0546	0.041	0.1131	0.0492	0.0507	0.0387	24	23
15	6.84	2.72	5.12	5.09	9.35	0.1707	0.08	0.1202	0.1136	0.1018	0.1165	0.0653	29	32
16	11.94	9.29	7.58	9.35	9.79	0.1226	0.0678	0.1162	0.1442	0.0557	0.0924	0.0939	27	24
17	6.84	2.72	5.12	5.09	9.35	0.1707	0.08	0.1202	0.1136	0.1018	0.1165	0.0653	27	25
18	8.94	1.07	4.53	1.11	4.53	0.1804	0.0564	0.0586	0.1887	0.2663	0.2599	0.1327	19	18
19	2.65	1.16	2.35	6.29	5.41	0.0847	0.0466	0.0853	0.0709	0.0547	0.0637	0.0448	18	22
20	6.01	2.14	4.06	4.49	3.17	0.1306	0.0514	0.0384	0.1786	0.1491	0.1474	0.1856	25	27
21	8.16	11.32	4.73	3.74	9.06	0.11	0.048	0.062	0.1281	0.0531	0.013	0.0862	17	21
22	9.13	13.22	7.48	9.93	12.65	0.1758	0.0336	0.1304	0.2231	0.0693	0.1045	0.1167	18	20
23	12.65	14.31	3.39	3.6	4.34	0.0669	0.1275	0.1382	0.0444	0.1149	0.0891	0.0637	19	18
24	6.93	8.6	14.4	9.76	7.48	0.0396	0.0546	0.041	0.1131	0.0492	0.0507	0.0387	27	29
25	6.83	8.98	7.41	6.92	11.3	0.284	0.0537	0.0489	0.3193	0.0771	0.0582	0.1102	17	19
26	6.84	2.72	5.12	5.09	9.35	0.1707	0.08	0.1202	0.1136	0.1018	0.1165	0.0653	22	25
27	8.94	1.07	4.53	1.11	4.53	0.1804	0.0564	0.0586	0.1887	0.2663	0.2599	0.1327	15	18
28	6.83	8.98	7.41	6.92	11.3	0.284	0.0537	0.0489	0.3193	0.0771	0.0582	0.1102	25	27
29	9.13	13.22	7.48	9.93	12.65	0.1758	0.0336	0.1304	0.2231	0.0693	0.1045	0.1167	19	18
30	6.83	8.98	7.41	6.92	11.3	0.284	0.0537	0.0489	0.3193	0.0771	0.0582	0.1102	26	25
31	9.13	13.22	7.48	9.93	12.65	0.1758	0.0336	0.1304	0.2231	0.0693	0.1045	0.1167	28	27
32	8.16	11.32	4.73	3.74	9.06	0.11	0.048	0.062	0.1281	0.0531	0.013	0.0862	19	17
33	6.83	8.98	7.41	6.92	11.3	0.284	0.0537	0.0489	0.3193	0.0771	0.0582	0.1102	20	18
34	8.16	11.32	4.73	3.74	9.06	0.11	0.048	0.062	0.1281	0.0531	0.013	0.0862	24	25
35	6.84	2.72	5.12	5.09	9.35	0.1707	0.08	0.1202	0.1136	0.1018	0.1165	0.0653	28	31
36	8.16	11.32	4.73	3.74	9.06	0.11	0.048	0.062	0.1281	0.0531	0.013	0.0862	22	20
37	6.84	2.72	5.12	5.09	9.35	0.1707	0.08	0.1202	0.1136	0.1018	0.1165	0.0653	20	18
38	6.84	2.72	5.12	5.09	9.35	0.1707	0.08	0.1202	0.1136	0.1018	0.1165	0.0653	29	32

	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP
	STANDAR	STANDA	STANDA	STANDA	STANDA	JITTER	JITTER	JITTE	JITTE	JITTER	JITTE	JITTER	SHIMMER 1	SHIMMER
1	50.54	4.88	22.48	34.75	22.59	2.48	2.45	3.05	1.36	1.24	2.35	1.36	14.19	7.93
2	10.52	18.29	11.27	16.13	32.5	1.9	1.06	1.21	0.94	1.76	1.97	1.9	14.41	6.75
3	51.94	45.03	54.04	48.19	19.79	2.53	2.86	3.04	2.88	3.26	3.29	1.19	12.87	13.37
4	2.26	4.6	2.54	1.77	31.88	1.26	0.69	0.97	0.99	0.74	0.6	2.27	5.86	5.52
5	24.25	12.91	36.73	42.78	8.39	2.76	1.83	1.21	0.95	5.83	3.05	1.19	10.29	6.09
6	48.56	49.81	14.1	22.17	17.61	2.35	3.05	2.65	2.19	0.81	1.79	1.49	10.98	13.2
7	8.81	105.28	56.95	51.31	43.53	1.12	13.9	1.05	1.89	1.83	1.31	1.86	9.5	34.29
8	74.88	31.92	77.33	17.41	36.81	0.8	2.4	2.69	0.64	1.8	1.68	2.36	1.41	7.5
9	49.86	18.1	18.84	64.14	37.27	0.96	2.32	1.13	1.03	3.47	2.5	2.01	2.07	3.24
10	30.88	3.13	4.48	27.99	12.25	1.08	1.14	1.41	0.46	1.45	1.19	1.41	5.8	4.92
11	20.52	18.29	11.27	16.13	22.5	1.8	1.16	1.21	0.94	1.66	1.87	1.9	14.41	6.65
12	50.54	4.88	22.48	34.75	22.59	2.48	2.45	3.05	1.36	1.24	2.35	1.36	14.19	7.93
13	51.94	45.03	54.04	48.19	19.79	2.53	2.86	3.04	2.88	3.26	3.29	1.19	12.87	13.37
14	24.25	12.91	36.73	42.78	8.39	2.76	1.83	1.21	0.95	5.83	3.05	1.19	10.29	6.09
15	2.26	4.6	2.54	1.77	31.88	1.26	0.69	0.97	0.99	0.74	0.6	2.27	5.86	5.52
16	48.56	49.81	14.1	22.17	17.61	2.35	3.05	2.65	2.19	0.81	1.79	1.49	10.98	13.2
17	2.26	4.6	2.54	1.77	31.88	1.26	0.69	0.97	0.99	0.74	0.6	2.27	5.86	5.52
18	74.88	31.92	77.33	17.41	36.81	0.8	2.4	2.69	0.64	1.8	1.68	2.36	1.41	7.5
19	49.86	18.1	18.84	64.14	37.27	0.96	2.32	1.13	1.03	3.47	2.5	2.01	2.07	3.24
20	30.88	3.13	4.48	27.99	12.25	1.08	1.14	1.41	0.46	1.45	1.19	1.41	5.8	4.92
21	50.54	4.88	22.48	34.75	22.59	2.48	2.45	3.05	1.36	1.24	2.35	1.36	14.19	7.93
22	8.81	105.28	56.95	51.31	43.53	1.12	13.9	1.05	1.89	1.83	1.41	1.86	9.5	34.29
23	51.94	45.03	54.04	48.19	19.79	2.53	2.86	3.04	2.88	3.26	3.29	1.19	12.87	13.37
24	24.25	12.91	36.73	42.78	8.39	2.76	1.83	1.21	0.95	5.83	3.05	1.19	10.29	6.09
25	20.52	18.29	11.27	16.13	22.5	1.8	1.16	1.21	0.94	1.66	1.87	1.9	14.41	6.65
26	2.26	4.6	2.54	1.77	31.88	1.26	0.69	0.97	0.99	0.74	0.6	2.27	5.86	5.52
27	74.88	31.92	77.33	17.41	36.81	0.8	2.4	2.69	0.64	1.8	1.68	2.36	1.41	7.5
28	20.52	18.29	11.27	16.13	22.5	1.8	1.16	1.21	0.94	1.66	1.87	1.9	14.41	6.65
29	8.81	105.28	56.95	51.31	43.53	1.12	13.9	1.05	1.89	1.83	1.41	1.86	9.5	34.29
30	20.52	18.29	11.27	16.13	22.5	1.8	1.16	1.21	0.94	1.66	1.87	1.9	14.41	6.65
31	8.81	105.28	56.95	51.31	43.53	1.12	13.9	1.05	1.89	1.83	1.41	1.86	9.5	34.29
32	50.54	4.88	22.48	34.75	22.59	2.48	2.45	3.05	1.36	1.24	2.35	1.36	14.19	7.93
33	20.52	18.29	11.27	16.13	22.5	1.8	1.16	1.21	0.94	1.66	1.87	1.9	14.41	6.65
34	50.54	4.88	22.48	34.75	22.59	2.48	2.45	3.05	1.36	1.24	2.35	1.36	14.19	7.93
35	2.26	4.6	2.54	1.77	31.88	1.26	0.69	0.97	0.99	0.74	0.6	2.27	5.86	5.52
36	50.54	4.88	22.48	34.75	22.59	2.48	2.45	3.05	1.36	1.24	2.35	1.36	14.19	7.93
37	2.26	4.6	2.54	1.77	31.88	1.26	0.69	0.97	0.99	0.74	0.6	2.27	5.86	5.52
38	2.26	4.6	2.54	1.77	31.88	1.26	0.69	0.97	0.99	0.74	0.6	2.27	5.86	5.52

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
	TAL	LESION	ON OF	TION	ONS	EAN PIT	PIT(LO	AN PIT	N PIT	MEAN	EAN PIT	SP)MEAN	DEVIATION OF	D
1	2	2	1	2	1	201.2	220.7	194.6	243.97	262.56	213.7	248.37	65.5	22.34
2	2	2	2	2	2	172.26	176.53	172.44	192.3	192.7	190.67	187.91	46.52	10.31
3	2	3	4	2	3	253.52	235.56	233.98	238.2	235.73	245.12	253.11	24.34	37.77
4	2	2	4	2	3	125.27	122.31	120.7	142.46	138.63	140.26	144.31	12.58	20.89
5	2	3	4	1	3	215.21	204.83	203.04	223.05	220.27	211.88	197.36	16.44	6.05
6	2	2	1	2	1	211.28	187.78	139.55	187.06	244.12	212.42	228.76	34.41	48.39
7	2	2	1	2	1	117.5	97.47	123.82	180.88	167.46	153.94	154.58	30.31	29.33
8	2	2	2	2	2	192.47	198.28	227.22	181.15	226.26	200.35	184.06	48.77	58.06
9	2	3	**4**	2	3	203.14	211.49	211.45	202.02	213.89	196.82	210.54	19.42	30.93
10	2	2	2	2	2	213.9	221.87	217.48	238.32	242.16	246.01	207.35	23.2	5.05
11	2	2	2	2	2	162.26	186.53	172.44	182.3	202.7	190.67	187.91	36.52	20.31
12	2	3	4	2	3	201.2	220.7	194.6	243.97	262.56	213.7	248.37	65.5	22.34
13	2	3	4	2	3	253.52	235.56	233.98	238.2	235.73	245.12	253.11	24.34	37.77
14	2	3	4	2	3	215.21	204.83	203.04	223.05	220.27	211.88	197.36	16.44	6.05
15	2	1	1	2	1	125.27	122.31	120.7	142.46	138.63	140.26	144.31	12.58	20.89
16	2	3	4	2	3	211.28	187.78	139.55	187.06	244.12	212.42	228.76	34.41	48.39
17	2	2	**4**	2	3	127.27	124.31	120.7	132.46	139.63	138.26	134.31	12.58	20.89
18	2	2	2	2	2	192.47	198.28	227.22	181.15	226.26	200.35	184.06	48.77	58.06
19	2	3	2	2	2	203.14	211.49	211.45	202.02	213.89	196.82	210.54	19.42	30.93
20	2	3	4	2	3	213.9	221.87	217.48	238.32	242.16	246.01	207.35	23.2	5.05
21	2	1	2	2	2	201.2	220.7	194.6	243.97	262.56	213.7	248.37	65.5	22.34
22	2	1	2	2	2	117.5	97.47	123.82	180.88	167.46	153.94	154.58	30.31	29.33
23	2	3	2	2	2	253.52	235.56	233.98	238.2	235.73	245.12	253.11	24.34	37.77
24	2	3	4	2	3	215.21	204.83	203.04	223.05	220.27	211.88	197.36	16.44	6.05
25	2	1	2	2	2	152.26	176.53	172.44	182.3	202.7	190.67	187.91	36.52	20.31
26	2	2	**4**	2	3	127.27	124.31	120.7	132.46	139.63	138.26	134.31	12.58	20.89
27	2	2	2	2	2	192.47	198.28	227.22	181.15	226.26	200.35	184.06	48.77	58.06
28	2	1	4	2	3	162.26	186.53	172.44	182.3	202.7	190.67	187.91	36.52	20.31
29	2	1	2	2	2	117.5	97.47	123.82	180.88	167.46	153.94	154.58	30.31	29.33
30	2	1	4	2	3	162.26	186.53	172.44	182.3	202.7	190.67	187.91	36.52	20.31
31	2	2	**4**	2	3	119.5	97.47	123.82	180.88	167.46	153.94	154.58	30.31	29.33
32	2	1	2	2	2	201.2	220.7	194.6	243.97	262.56	213.7	248.37	65.5	22.34
33	2	2	2	2	2	162.26	186.53	172.44	182.3	202.7	190.67	187.91	36.52	20.31
34	2	3	4	2	3	201.2	220.7	194.6	243.97	262.56	213.7	248.37	65.5	22.34
35	2	1	1	2	1	127.27	124.31	120.7	132.46	139.63	138.26	134.31	12.58	20.89
36	2	1	2	2	2	201.2	220.7	194.6	243.97	262.56	213.7	248.37	65.5	22.34
37	2	2	2	2	2	137.27	124.31	110.7	132.46	139.63	128.26	134.31	12.58	20.89
38	2	1	1	2	1	127.27	124.31	120.7	132.46	139.63	138.26	134.31	12.58	20.89